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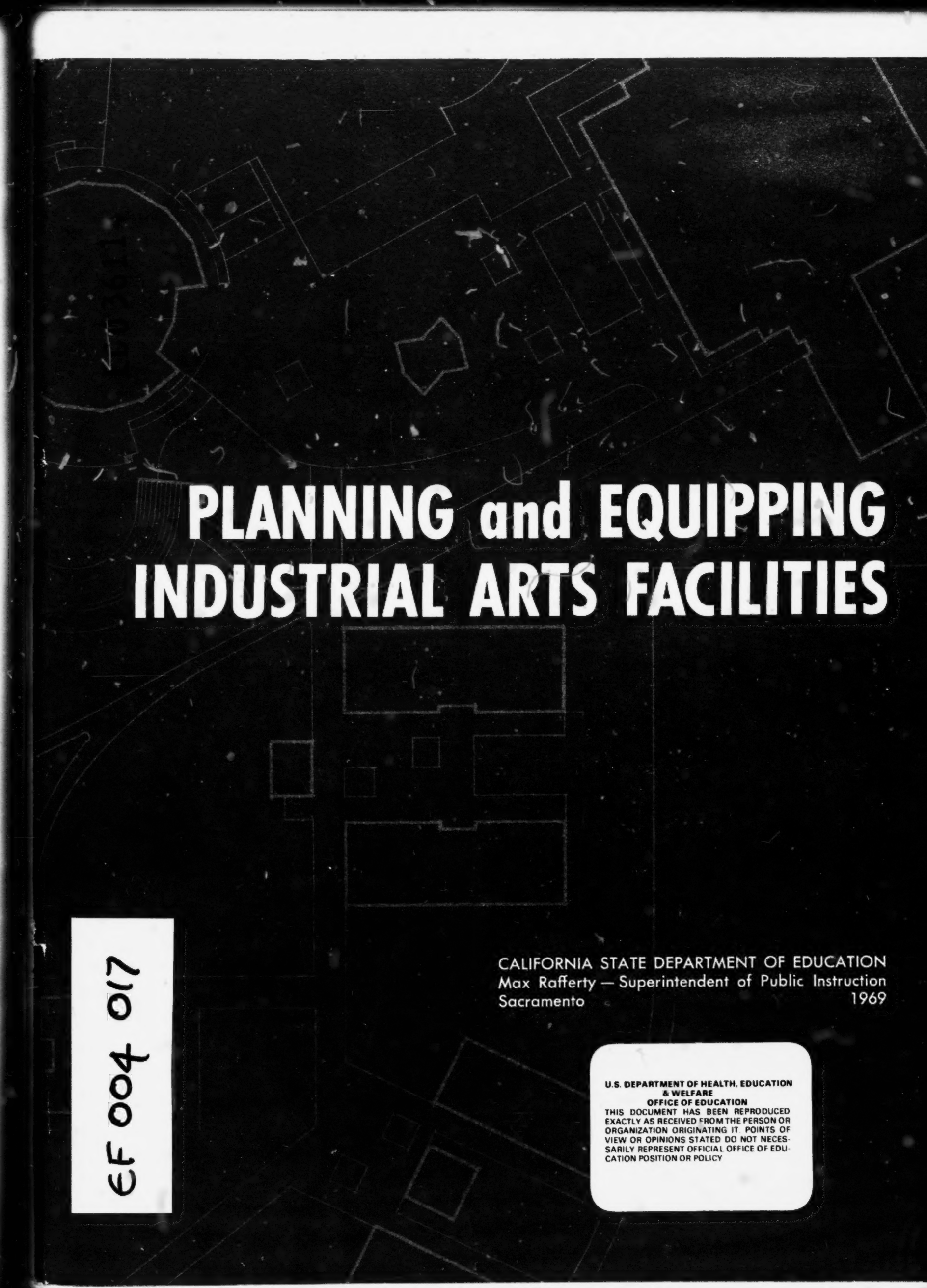
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ABSTRACT

GUIDELINES FOR SECONDARY EDUCATION, INDUSTRIAL ARTS
PROGRAMS AND FACILITY PLANNING ARE OVERVIEWED ALONG WITH DATA ON
THEIR INSTRUCTIONAL AND EQUIPMENT NEEDS. SPATIAL ORGANIZATION AND
DIMENSIONS ARE SUGGESTED IN TERMS OF FLEXIBILITY AND EXPANSION.
DIFFERENT TYPES OF SHOPS ARE DISCUSSED ALONG WITH THEIR OWN
UTILITIES, VENTILATION, EXHAUSTING, STORAGE AND LIGHTING NEEDS.
PHOTOGRAPHS AND FLOOR PLANS ARE INCLUDED. (TG)

The background of the cover is a dark, high-contrast architectural drawing. It features various geometric shapes, including rectangles, squares, and a large semi-circle on the left side. Lines and arrows are scattered throughout, suggesting a complex plan or layout of a facility.

PLANNING and EQUIPPING INDUSTRIAL ARTS FACILITIES

EF 004 017

CALIFORNIA STATE DEPARTMENT OF EDUCATION
Max Rafferty — Superintendent of Public Instruction
Sacramento 1969

U.S. DEPARTMENT OF HEALTH, EDUCATION
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PLANNING and EQUIPPING INDUSTRIAL ARTS FACILITIES

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FOREWORD

A substantial and modern program of education requires adequate and well-planned school plants. The continued enrollment growth coupled with the need to repair, reconstruct, or replace school buildings has made the provision of such plants a sizable problem for most school districts in California.

Industrial arts is an integral part of the total program of education provided in California schools. To keep this part of the program strong, appropriate facilities must be developed and made available for all industrial arts classes. Such facilities must be planned and developed by school personnel and architects who are fully cognizant of the requirements for a modern industrial arts program. The information presented in *Planning and Equipping Industrial Arts Facilities* will be most helpful in fulfilling this responsibility.

The educational specifications for industrial arts facilities, the detailed facility plans, and the lists of major kinds and quantities of equipment provided by school districts are included in this publication. This information should be of great value to educators who desire to develop and maintain a well-rounded program of education in California schools.

A handwritten signature in black ink, reading "Max Rafferty". The signature is fluid and cursive, with the first name "Max" and last name "Rafferty" clearly distinguishable.

Superintendent of Public Instruction

PREFACE

Planning and Equipping Industrial Arts Facilities replaces the *Guide for Planning and Equipping Industrial Arts Shops in California Schools*, which was published by the California State Department of Education in 1956.

Planning and Equipping Industrial Arts Facilities updates the information provided in the earlier guide and, in addition, (1) presents an overview of California's industrial arts program in the elementary schools, junior high schools, and high schools; (2) introduces shop/laboratory plans and equipment lists for the areas of photography, plastics, and power mechanics; and (3) offers information concerning industrial arts activities in the elementary schools (kindergarten and grades one through six). This publication is designed to assist personnel in planning industrial arts facilities in schools and districts organized to accommodate kindergarten and grades one through six; grades seven and eight or seven through nine; and grades nine through twelve or ten through twelve. The information presented may be modified to cover other types of school organization.

The original planning and equipping publication proved to be of invaluable assistance to California administrators, architects, teachers, and supervisors in planning industrial arts facilities or remodeling existing facilities and has received both national and international recognition. Information and plans presented in the California publication were used in *Planning Industrial Arts Facilities*, the Eighth Year Book (1959) of the American Council on Industrial Arts Teacher Education, an affiliate of the American Industrial Arts Association and the National Education Association. And the California publication was translated into Spanish by the Agency for International Development, Mexico, in 1964 (*Guia para Planear y Equipar Talleres de Artes Industriales en las Escuelas de California*) and distributed to the technical schools in Mexico and Central and South America.

Selected teachers, supervisors, and teacher educators in California educational institutions assisted in the development of the shop/laboratory plans and provided information for the equipment tables and lists for *Planning and Equipping Industrial Arts Facilities*. The drawings of the plans were prepared by an architectural firm as a special project under the National Defense Education Act. Illustrations (drawings and photographs) were furnished by selected architects and school districts. Those participating in the preparation of material for this publication are named in the acknowledgments section.

It is hoped that *Planning and Equipping Industrial Arts Facilities* will further the improvement of industrial arts facilities for all youth in California schools.

EUGENE GONZALES
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Public Instruction; and Chief,
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Much of the material developed for this publication is based on the information presented in the *Guide for Planning and Equipping Industrial Arts Shops in California Schools*, which was prepared by the California Industrial Arts Shop Planning Committee and published by the California State Department of Education in 1956. Members of the committee were:

George F. Chambers, Committee Chairman, Richmond Unified School District; *Doyt Early*, California State Department of Education (Retired); *Adolph W. Ehrhorn*, Sacramento City Unified School District (Deceased); *Robert E. Gilbert*, Oakland Unified School District (Deceased); *Daniel C. Lopez*, San Jose State College; *Harry J. Loucks*, Office of Sonoma County Superintendent of Schools, Santa Rosa; *Jess E. Rathbun*, San Francisco Unified School District; *Jack E. Reynolds*, Sacramento City Unified School District; *John P. Satterstrom*, Committee Secretary, Office of Santa Clara County Superintendent of Schools, San Jose; *Paul L. Scherer*, University of California, Santa Barbara; *Heber A. Sotzin*, San Jose State College (Deceased); *James E. Stevenson*, San Jose State College; *Howard J. Warren*, Office of Monterey County Superintendent of Schools, Salinas; and *Robert L. Woodward*, Committee Consultant, California State Department of Education.

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Plans (figures 1 through 17) presented in this publication were prepared by the following members of the architectural firm of *Woodward and Nichols*, A.I.A., Redding: Architects, *Willard M. Woodward* and *Eugene L. Nichols*; and Associate, *Dennis J. Parker*.

Preparation of the material for *Planning and Equipping Industrial Arts Facilities* was coordinated by *Robert L. Woodward* and *Norman L. Myers*, Consultants in Industrial Arts Education, California State Department of Education.

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California's Industrial Arts Program

Industrial arts in California schools is an integral part of the total program of education and is designed specifically to help prepare students to meet the requirements of an industrial-technological culture. In this program, which involves study, experimentation, and application, students learn through participation in activities in which they use industrial-technical tools, machines, materials, and processes, as well as English, mathematics, science, and social sciences in solving meaningful problems.

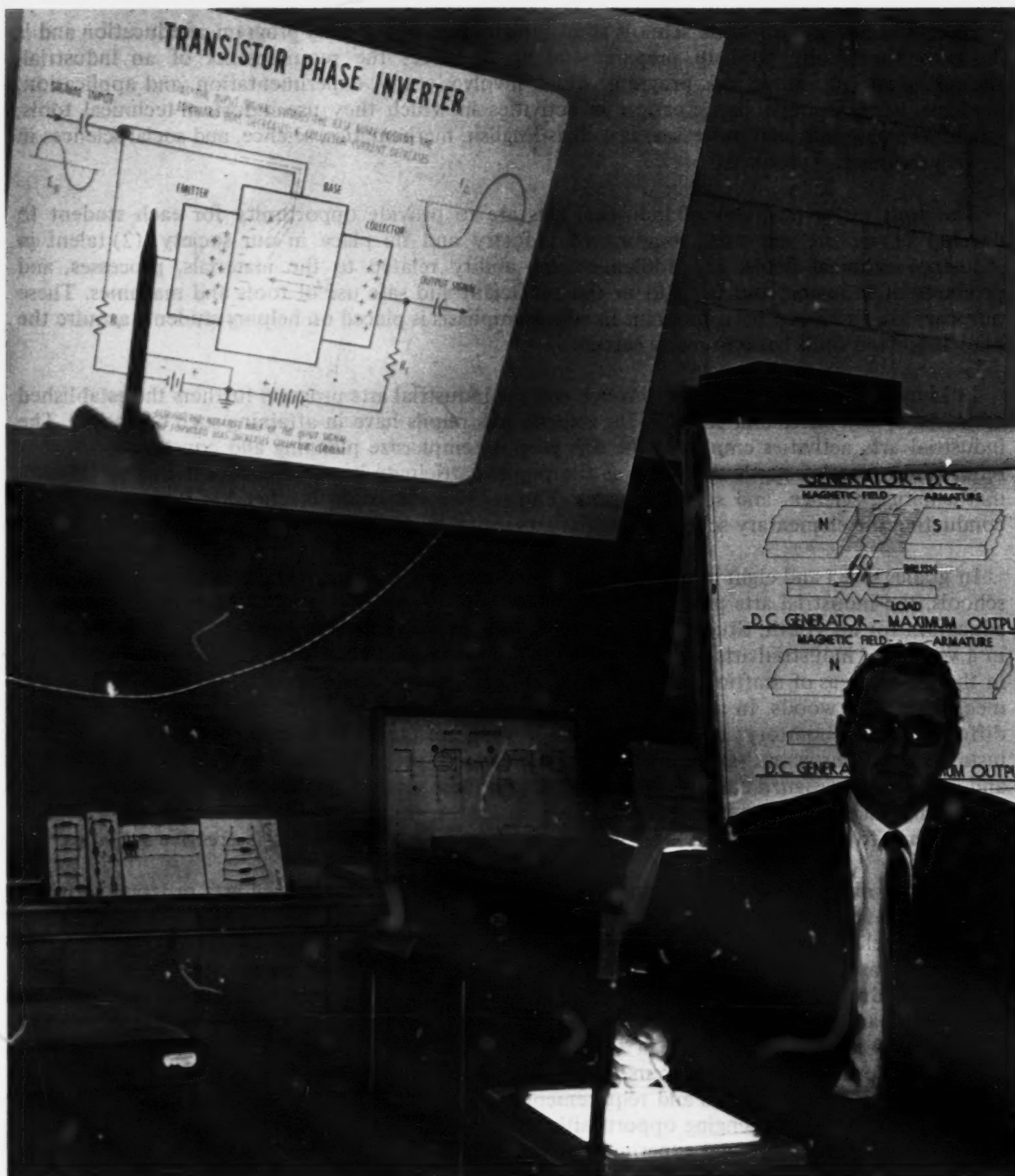
The four major purposes of industrial arts are to provide opportunity for each student to develop (1) insight and understanding of industry and its place in our society; (2) talent in industrial-technical fields; (3) problem-solving ability related to the materials, processes, and products of industry; and (4) skill in the proficient and safe use of tools and machines. These purposes are furthered by a program in which emphasis is placed on helping students acquire the knowledge and skills basic to many careers.

In kindergarten and grades one through six, the industrial arts program furthers the established educational objectives and enriches the experiences pupils have in attaining such objectives. The industrial arts activities employed for this purpose emphasize planning and construction that is required in meeting needs that arise as the pupils participate in experiences relating to English, mathematics, science, and social sciences. The regular classroom teacher has responsibility for conducting the elementary school industrial arts program.

In grades seven and eight of elementary schools and grades seven, eight, and nine of junior high schools, the industrial arts program is an integral and often required part of the total program of education for all youth. Students are usually guided through a series of introductory experiences in a variety of industrial arts areas. Included in the program are courses which provide instruction in the broad areas of drafting, electricity/electronics, graphic arts, industrial crafts, metals, power mechanics, and woods. In a large school, each of these areas of instruction is often taught in a different shop/laboratory; in a small school, several are taught in one shop/laboratory. In each instance, the courses are taught by teachers with special preparation in the field of industrial arts and in specially designed and equipped facilities. In these grades, emphasis and attention are given to helping students discover and further their aptitudes, abilities, and interests. Provision is made for students to acquire a variety of skills and to profit from participation in creative activities.

In grades nine through twelve and ten through twelve, the industrial arts program provides opportunity for the high school student, regardless of his major, to choose the industrial arts courses he believes will be of the greatest value to him in attaining the goal he is seeking. Included in the program are elective courses which provide instruction in the broad areas of automotive mechanics, drafting, electronics, graphic arts, industrial crafts, metals, photography, plastics, power mechanics, and woods. These courses are taught by teachers with special preparation in the field of industrial arts and in specially designed and equipped facilities. The advanced techniques developed in these courses approach the procedures used in industry. At this level, emphasis is given to practices and requirements of occupations and professions relating to each industrial arts area. Challenging opportunities are provided for scientifically and mathematically oriented students to work and experiment with new materials, processes, ideas, and designs.

Knowledge and skills acquired and the experience gained through participation in the industrial arts program assist individuals to select careers wisely and to participate successfully in programs of education and training offered by institutions of higher learning, industry, and government which provide further preparation needed for the chosen careers.



The industrial arts teacher reinforces his instruction through the use of visual aids.

Educational Specifications for Industrial Arts Facilities

Educational specifications, organized under eight phases of industrial arts facility planning, are presented in this section. These phases are location and housing, flexibility and expansibility, size of shops/laboratories, open shop/laboratory area, auxiliary rooms and areas, visual comfort and efficiency, ventilation and heating, and floors and surfaces.

A. Location and Housing

1. The site area devoted to industrial arts facilities should be adjacent to or connected with the other areas used for educational purposes and easily accessible by automobile and truck. An adequate parking area should be provided.
2. Shops/laboratories in which noisy activities are conducted should be located so that the noise will not disturb other educational activities.
3. Facilities for automotive/power mechanics and other shops/laboratories that must be accessible to automobiles and trucks should have service entrances and exits located adjacent to driveways.
4. Industrial arts facilities should be located so that they are easily accessible for evening school use.
5. Shops/laboratories should be housed in one or more buildings or in a section of a school building that are planned and designed for industrial arts activities.
6. Industrial arts buildings or shop/laboratory sections of school buildings should be one-story structures.
7. Buildings should be connected by covered walks where climatic conditions make it necessary.
8. Ceiling height of a shop/laboratory should be a minimum of 12 feet, preferably 14 feet. Additional height for a hydraulic car lift or vertical storage of materials should be provided when necessary.
9. Shops/laboratories should be acoustically treated with material that will permit repeated refinishing.
10. Industrial arts facility construction and installations should meet the standards set by the California State Department of Education, State Architect, State Fire Marshal, and Division of Industrial Safety.

B. Flexibility and Expansibility

11. Nonbearing partitions may be used between shops/laboratories to obtain flexibility.
12. Windows should be provided along the entire wall for each open shop/laboratory area.

13. Installations for power and other utilities should be based on a liberal rather than on a restricted estimate of future needs.
14. Standard types of cabinets, lockers, shelves, and workbenches should be used in all industrial arts facilities.
15. Shelving in cabinets, lockers, and other areas requiring shelves should be adjustable except where safety dictates rigid shelving.
16. The site area devoted to industrial arts facilities should be large enough to provide for future expansion.

C. Size of Shops/Laboratories

17. The space allotted for an industrial arts shop/laboratory should be adequate to provide for the various activities, including space for the proper installation and operation of equipment. The following space allotments are recommended as guides in determining space requirements for the *open shop/laboratory area*. These allotments are based on a class size of 24 students. Space for auxiliary rooms should be added to the allotments for open shop/laboratory areas.

Space Allotments Recommended for Open Shop/Laboratory Area in Industrial Arts Facilities (24 Students)

Group I Shops/Laboratories

Automotive mechanics,¹ electronics, graphic arts, metals, photography, plastics, power mechanics,¹ woods, and general industrial arts for grades nine through twelve or ten through twelve; metals, woods, and general industrial arts for grades seven and eight or seven through nine.

<i>Space</i>	<i>Square feet per student</i>	<i>Open shop/laboratory area total square footage</i>
Minimum	75	1,800
Adequate	100	2,400
Desirable	125	3,000

Group II Shops/Laboratories

Drafting² and industrial crafts for grades seven through twelve; electricity/electronics and graphic arts for grades seven and eight or seven through nine.

<i>Space</i>	<i>Square feet per student</i>	<i>Open shop/laboratory area total square footage</i>
Minimum	50	1,200
Adequate	75	1,800
Desirable	100	2,400

¹In automotive mechanics and power mechanics facilities, the open shop/laboratory area exceeds 2,400 square feet because of the space required for the servicing and repairing of automobiles and other vehicles.

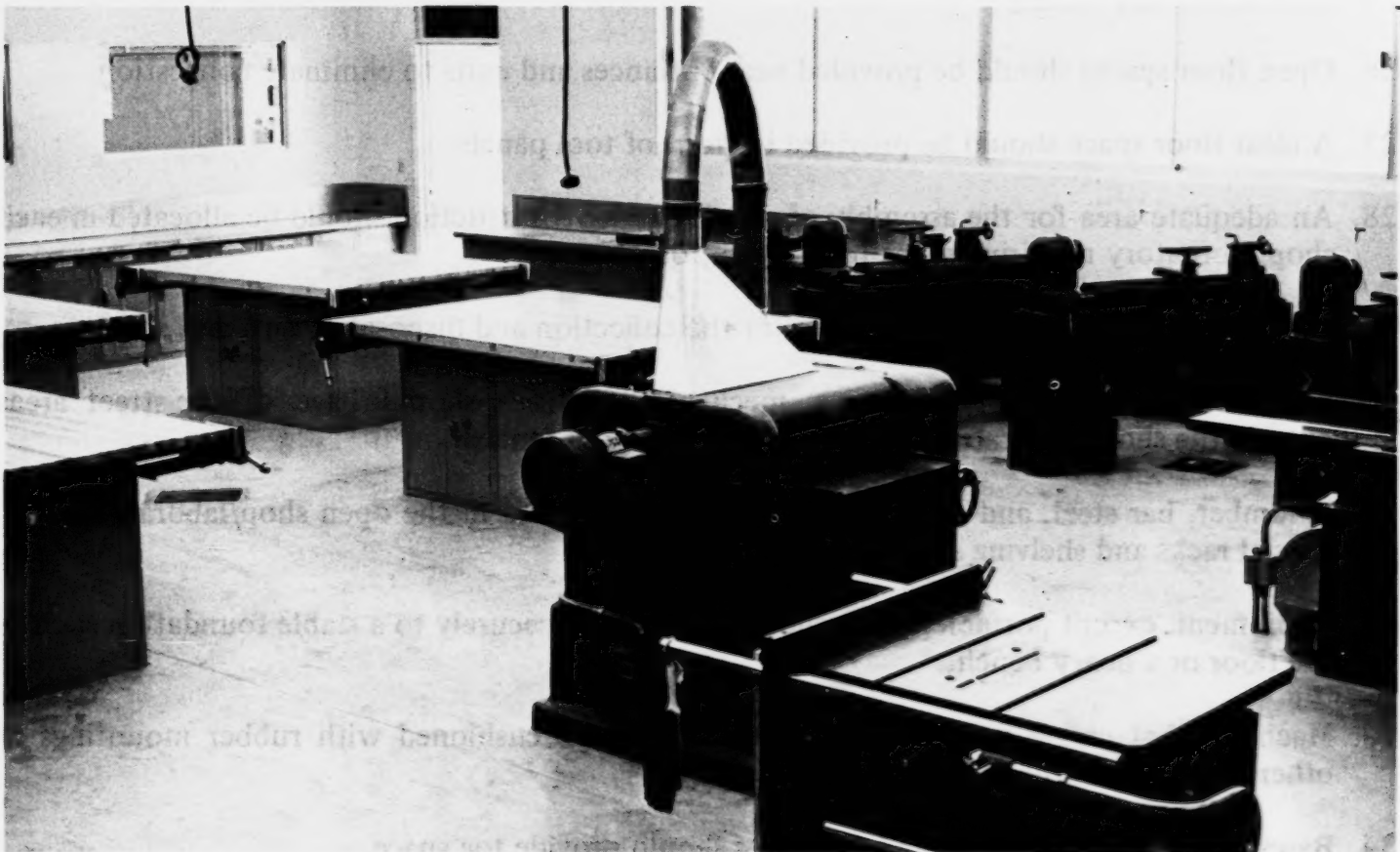
²The drafting facility is based on a class size of 30 students because of the nature of the activity.

18. The open shop/laboratory area should be rectangular in shape.
19. The width-to-length ratio of the open shop/laboratory area should be approximately 2:3.

D. Open Shop/Laboratory Area

20. The entire open shop/laboratory area should be visible from any point.
21. Arrangement of equipment (including machines) and student stations should be determined by considerations of safety, work procedures, flow of materials, and instructional efficiency.
22. Aisles of travel should be provided for free flow of traffic between all areas and points of common use; such as, auxiliary rooms, tool panels, and common machine areas. These aisles should be at least 4 feet in width.
23. Spacing between benches, machinery, and other equipment should be sufficient for students' safety and for free passage. The amount of space between benches, machinery, and other equipment is determined by the nature of the industrial arts activities and the equipment, but in all instances should be at least 3 feet.
24. Operators' zones at machines should be designated on the floor by taped or painted lines.
25. All shops/laboratories should have at least two entrance-exit doors. One door should be large enough to accommodate the largest piece of equipment or instructional project to be moved in or out of the facility.
26. Open floor spaces should be provided near entrances and exits to eliminate congestion.
27. A clear floor space should be provided in front of tool panels.
28. An adequate area for the assembly of articles under construction should be allocated in each shop/laboratory requiring space for this purpose.
29. Adequate systems should be provided for the collection and disposal of dust and shavings.
30. Automotive mechanics and power mechanics facilities should have off-the-street areas outside the shops/laboratories which are surfaced and fenced.
31. If lumber, bar steel, and other materials are to be stored in the open shop/laboratory area, special racks and shelving should be provided.
32. Equipment, except portable types, should be fastened securely to a stable foundation such as the floor or a heavy bench.
33. Machines that create a vibration problem should be cushioned with rubber mountings or other shock-absorbing material.
34. Bases for cabinets, benches, and machines should provide toe space.
35. Equipment should be placed to allow for ease of cleaning around the base.
36. The operating level of equipment should be a comfortable working height for the students.

37. The start-stop switch on a machine should be located within easy reach of the operator.
38. Workbenches with lockers below should be provided where needed.
39. Machines that are used for roughing out stock should be placed near the storage areas.
40. Lockers should be provided for students' personal belongings and partially completed small articles. These lockers should be located in an area where they can be readily supervised by the teacher.
41. Illuminated display cases should be provided both in the shop/laboratory and in central locations in the school building.
42. Power controls should be centralized on a master control panel that can be locked and is located near the teacher's desk or office. Remote safety relay cutout switches controlling the main power supply may also be provided.
43. Shops/laboratories in which portable power tools are used should be provided with electrical outlets with provision for grounding.
44. Adequate washing facilities and a drinking fountain should be provided in each shop/laboratory. Hot water should be available in each shop/laboratory.
45. Tack boards and chalkboards should be placed at strategic locations in each facility.



An industrial arts woods facility in a high school in the San Diego City Unified School District includes a separate shop/laboratory classroom (note supervision window at left), an area with four-station benches, and a well-equipped machine area.

46. Fire extinguishers are required equipment and must be located conveniently and marked or labeled conspicuously.
47. Provision should be made for the location of a first-aid kit.
48. Space should be set aside in each shop/laboratory for waste and refuse containers.

E. Auxiliary Rooms and Areas

49. All shop/laboratory auxiliary rooms and areas should be planned at the same time as the rest of the facility. Among these are rooms or areas for supplies and special tools; project storage; instruction; planning, library, and office; finishing; and material storage.
50. Each shop/laboratory should have an auxiliary room for supplies and special tools. The size is determined by the nature of the industrial arts activities, the number of students enrolled, and the type and quantity of supplies and tools stored.
51. The material storage room or area should be located conveniently for the unloading of delivery trucks and for issuing materials to the students.
52. Rooms for the storage of supplies and special tools and articles under construction used by evening classes should be provided in facilities that are to be used extensively by evening classes.
53. Both the supplies and special tools room and the tool panel should be so located that students, in reaching them and returning to their work stations, pass as few work stations as possible.
54. Racks, shelving, drawers, and closed cabinets designed for items to be stored should be provided in the supplies and special tools room.
55. A classroom of 480 square feet (20 X 24 feet) is a highly desirable adjunct to most shops/laboratories for group instruction, planning, and study. A specially equipped instructional space (12 X 18 feet) in the open shop/laboratory area or a nearby regular classroom may be used for this purpose.
56. The shop/laboratory classroom should be equipped with a teacher's desk, necessary chairs and tables, adequate chalkboard and tack board, shelving for books, and cabinets for storage of instructional material. The room should be acoustically treated.
57. Shop/laboratory classrooms and regular classrooms used for industrial arts instructional purposes should be equipped for the use of audiovisual aids.
58. Controls for room lights in classrooms should be located where they may be used with a minimum of teacher movement. A sufficient number of electrical outlets should be provided for the various kinds of audiovisual equipment.
59. If instructional space in the open shop/laboratory area is used instead of a classroom, it should be provided with a teacher's desk, chalkboard, necessary seating, and cabinets for storage of instructional materials.

60. A separate dustproof finishing room equipped with a commercial-type spray booth is necessary for shops/laboratories in which finishing is done.
61. Toilet facilities for all shops/laboratories should be located at a central point in the industrial arts facility.
62. An air compressor unit should be located where (1) all shops/laboratories requiring compressed air may use it; (2) it can be conveniently serviced; and (3) noise from its operation will not disturb classes.

F. Visual Comfort and Efficiency

63. Full advantage should be taken of all possibilities for natural lighting. North light should be provided whenever possible.
64. When daylight is inadequate, it must be supplemented by sufficient electric light to provide illumination that meets adopted standards.
65. Artificial lighting systems should produce a uniform distribution of shadow-free light, and equipment and walls should be glare free.
66. Artificial lighting should be secured by the use of fixtures that produce indirect or semi-indirect light.
67. Artificial lighting for shops/laboratories in general should yield a minimum of 50 foot-candles on the work. Lighting for tasks that are difficult to see should provide 100 foot-candles or more.
68. General lighting should be supplemented by special lighting for each machine and for areas where precision work is done.
69. Ceilings should be painted an off-white. Walls, trim, and built-in equipment should be a light color.
70. Furniture and other shop/laboratory equipment should be finished in light colors.
71. Machinery and equipment should be painted in colors that are conducive to eye comfort and safety.
72. The machine body should be finished in a color that will create a visual working area that minimizes eye fatigue and strain.
73. Certain operating parts should be finished in colors that are in strong contrast to the machine body.
74. High visibility colors should be used on control levers and switch boxes, with black for starting button and red for stop button.

G. Ventilation and Heating

75. The heating and ventilating system should be adequate to maintain comfortable and healthful conditions at all times.

76. Dust, smoke, odors, fumes, vapors, and gases should be exhausted by mechanical means.
77. Provision should be made for all engines operated in the shops/laboratories to be muffled and connected to exhaust pipes that discharge outside the building.
78. The heating system should maintain automatically for shops/laboratories a temperature of 68° F. measured 60 inches above the floor; and for classrooms, a temperature of 70° F. measured 30 inches above the floor.
79. The temperature variation from floor to 60 inches above the floor should not exceed 5° F.

H. Floors and Surfaces

80. The floors should be pleasing in appearance, easy to clean, made of a material that will require a minimum of repairs, and finished to reduce the danger of slipping.
81. The flooring materials will differ from facility to facility according to the activities conducted in each shop/laboratory. For example, nonconducting (electricity) floor material should be used in electricity/electronics facilities.
82. Nonskid material should be installed on the floor in operators' zones.

Teacher Assistance in Planning Industrial Arts Facilities

Industrial arts teachers should participate in the planning of new industrial arts facilities and the alteration of existing facilities. The planning group thus has the services of specialists who know shop/laboratory requirements, and the planning group has assurance that as planning moves ahead the facilities included will be those needed in conducting a well-founded industrial arts program. These teachers can also make available for the planning group sketches, drawings, prints, and building scale models in which equipment is properly placed so as to give members of the group a realistic view of the proposed facilities and of the requirements for a program of industrial arts.

The first task in planning a good industrial arts facility is to identify the educational goals of the proposed industrial arts program and to determine how these goals will contribute to the total educational program. Consideration should also be given to the educational philosophy of the school and to the potential enrollment in industrial arts courses. In considering the enrollment, attention should be given to the number of students to be served in all phases of the industrial arts program and also to the needs and abilities of the students that may be enrolled in each phase of the program.

The well-trained and experienced industrial arts teacher can be extremely helpful in advising the planning group regarding the various matters that should be given consideration in planning shops/laboratories, among which are the following:

Building physical features and space utilization. (1) Types of shops/laboratories; (2) class size and number of student stations; (3) shop/laboratory size; (4) types of ceilings, floors, and walls; (5) height of ceilings; (6) size and spacing of windows; and (7) types of lighting — artificial, natural.

Architectural details. (1) Entrances and exits; (2) selection and placement of equipment; and (3) auxiliary rooms — classrooms, demonstration areas, finishing rooms, locker space, planning centers, display facilities, storage facilities (articles under construction, supplies, materials), teacher's office, tool panels, and audiovisual room.

Decorative features. (1) Types of paint and finishes; (2) color system for ceilings, walls, and floors; and (3) color system for equipment and its use.

Health and safety features. (1) Air compressors; (2) drinking fountains; (3) exhaust systems — blowers and fans; (4) fire precautions; (5) fire hoses and extinguishers; (6) heating and ventilating; (7) master control switch for power equipment; (8) noise factors; (9) sound-proofing; (10) toilet facilities; (11) wash sinks; and (12) other health and safety features considered essential.

Communication facilities. (1) Bells; (2) clocks; (3) intercommunication system; (4) radios; (5) telephones; and (6) televisions.

Steps in Planning Industrial Arts Facilities

The steps that should be taken in planning new facilities for industrial arts follow:

- Complete the educational planning required to determine the facilities needed. Such planning will include (1) examination of the educational philosophy of the school;

(2) prediction of future school needs; (3) organization of the school; (4) determination of student population to be served; (5) estimation of probable industrial arts enrollment; and (6) assessment of student capabilities and needs.

- Study the facilities in other school districts to determine the best current practices in housing and equipping industrial arts programs.
- Determine the courses of industrial arts education to be provided and the activities to be conducted in these courses.
- Determine the space required for (1) equipment; (2) work areas; (3) storage of materials, supplies, and articles under construction; (4) planning, library, and office; (5) finishing room; and (6) all other requirements for the activities to be conducted such as heating, dust collection, ventilation, and special electrical outlets and circuits.
- Prepare, in cooperation with all persons who are responsible for the planning of the facilities, sketches of the facilities needed and present them to the architect to use in the development of preliminary architectural drawings.
- Assist in any revisions that should be made in the preliminary drawings, and furnish such information as may be required for use in making the final drawings.
- Work with the architect and contractor during the period of construction.

Information Concerning Industrial Arts Facility Plans and Equipment Lists

The plans, tables, and equipment lists presented in this section should be of great value to the governing boards, administrators, architects, and industrial arts teachers and supervisors who have responsibility for planning the new facilities and equipment needed for an industrial arts program that will be provided by a school district or for remodeling/expanding the facilities for a program that is in operation.

The shop/laboratory plans for each area of industrial arts show the space requirements, the kinds of auxiliary rooms and areas that should be provided, and how the equipment can be located to be most serviceable. The tables present the kinds of major equipment and the quantities of each kind of this equipment that are provided in selected California school districts that are offering good programs of industrial arts. The lists of recommended equipment for areas not covered by the tables offer additional information. In these ways, a complete and somewhat detailed picture is presented to show the facilities and major equipment which are needed in conducting the various facets of an industrial arts program.

Industrial arts facilities are integral parts of the total school plant. The shop/laboratory plans presented in this section are uniformly 40 feet wide. This provision makes it possible to develop plans for the building of shops/laboratories end to end in a separate building or as a wing/section of a building.

The 17 plans (figures) for industrial arts facilities include those for shop/laboratory classrooms and instructional areas, automotive mechanics, drafting, electricity/electronics, graphic arts, industrial crafts, metals, photography, plastics, power mechanics, woods, and general industrial arts.

Figure 1 suggests separate classrooms or specified areas (alcoves) in the facility that can be used for instructional purposes. Several of the plans designate instructional areas in the open shop/laboratory area. Full consideration should be given to including a classroom or instructional area when space is being allocated for the industrial arts facility.

The plan for industrial arts automotive mechanics shop/laboratory, Figure 2, includes facilities for introductory and advanced courses in automotive mechanics for grades nine through twelve or ten through twelve. This plan is one in which provision is made for more than 100 square feet of open shop/laboratory area per student. Such an amount of space is necessary when instruction in introductory and advanced automotive mechanics is provided in one facility. When the introductory and advanced automotive mechanics courses are taught in separate shops/laboratories, the size of the open shop/laboratory area required must be determined in relation to the extent of the instructional program in each course. A separate classroom is essential for this area of industrial arts.

Figure 3 presents a plan for an industrial arts drafting facility. This plan may be adapted for use in grades seven and eight, seven through nine, nine through twelve, or ten through twelve. Space requirements for drafting are more dependent upon class size and standard furniture installations than upon the grade level or complexity of the courses.

Figures 4 and 5 are plans for industrial arts electricity/electronics facilities. Figure 4 is a shop/laboratory plan designed for electricity/electronics courses for grades seven and eight or seven through nine. Figure 5 presents a plan for an electronics laboratory for grades nine through

twelve or ten through twelve. This plan is accompanied by illustrations (photographs and drawings) showing two types of laboratory benches and two ways that the instructional areas may be provided in the facility.

Figures 6 and 7 are plans for industrial arts graphic arts facilities. One is designed for graphic arts courses for grades seven and eight or seven through nine; the other, for graphic arts courses for grades nine through twelve or ten through twelve. Figure 7A is a plan for a light trap that may be used at the entrance-exit of the photography laboratory provided in an auxiliary room of the graphic arts facility shown in Figure 7.

Figure 8 is a single plan for an industrial arts industrial crafts facility designed for industrial crafts courses for grades seven through twelve. The nature of the work done and the materials used at different grade levels are similar, and identical facilities may be used at the different grade levels.

Plans for industrial arts metals facilities for grades seven and eight or seven through nine and grades nine through twelve or ten through twelve, figures 9 and 10, are similar in layout. The major differences are the nature of the work stations and equipment and the sizes of the open shop/laboratory areas.

Figure 11 is a plan for an industrial arts photography facility which is designed for photography courses for grades nine through twelve or ten through twelve.

Figure 12 is a plan for an industrial arts plastics facility. This shop/laboratory is designed for plastics courses for grades nine through twelve or ten through twelve.

The plan for industrial arts power mechanics shop/laboratory, Figure 13, is designed primarily for power mechanics courses for grades nine through twelve or ten through twelve; however, this facility may also be used for automotive mechanics courses. A separate classroom is essential for this area of industrial arts.

Figures 14 and 15 are plans for industrial arts woods facilities. One is designed for woods courses for grades seven and eight or seven through nine; the other, for woods courses for grades nine through twelve or ten through twelve. Figure 14 shows ways of storing certain materials within the open shop/laboratory area. The purpose of illustrating this method of storage is to show planners how to take full advantage of the allocated space when planning shops/laboratories of limited size. However, it is recommended that auxiliary rooms should be provided for storage of materials whenever possible.

Figures 16 and 17 are plans for general industrial arts facilities (comprehensive general shop/laboratories) for general industrial arts courses for grades seven and eight or seven through nine and grades nine through twelve or ten through twelve. A general industrial arts shop/laboratory is one in which facilities are provided for a variety of student experiences in two or more areas; such as drafting, electricity/electronics, metals, and woods. This type of shop/laboratory is recommended for schools in which the total enrollment is small.

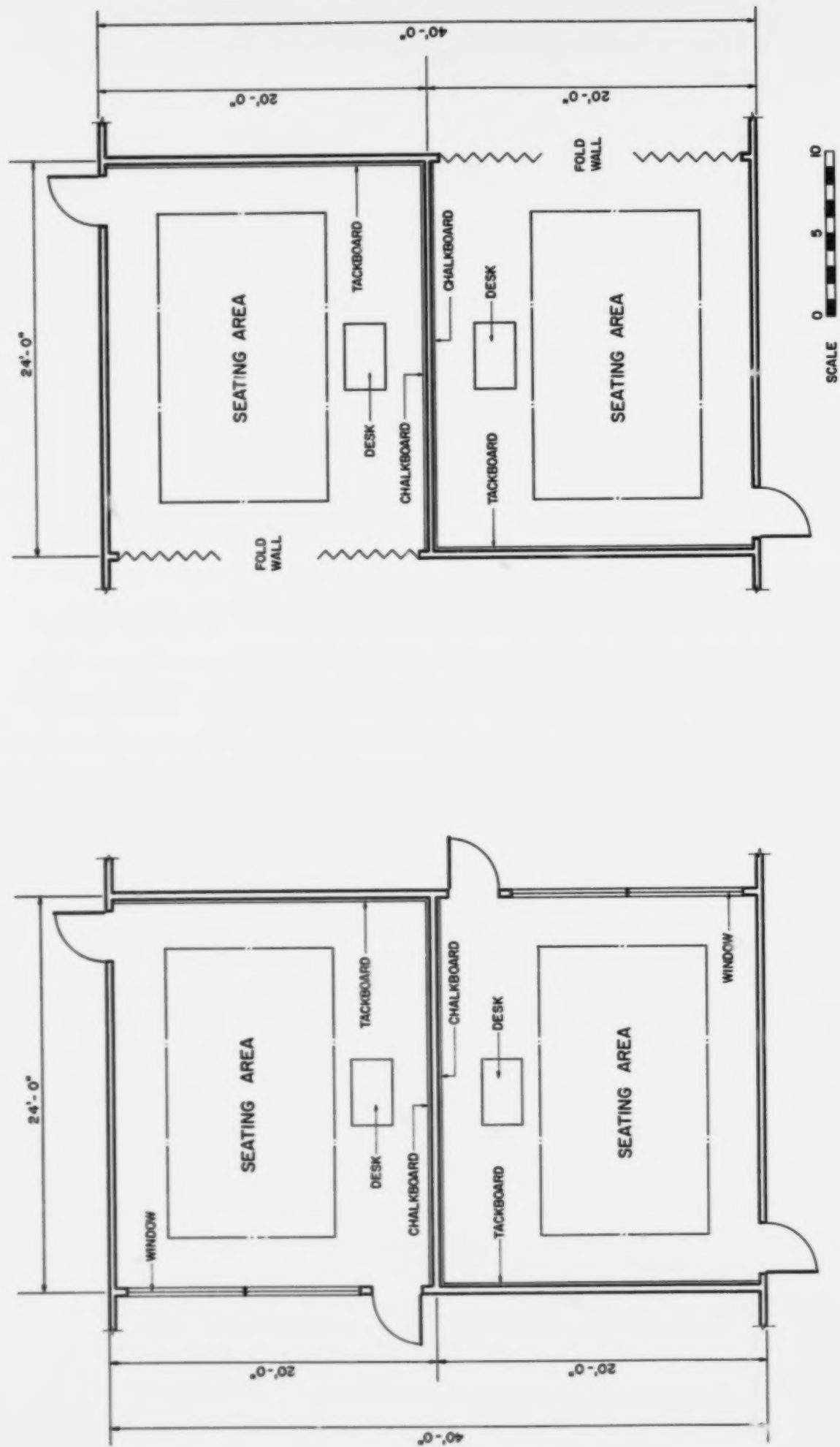


Figure 1. Industrial Arts Shop/Laboratory Classrooms and Instructional Areas

Methods of Providing for Group Instruction

A sound program of industrial arts education makes provision for group instruction. This may be accomplished by providing shop/laboratory classrooms or instructional areas (alcoves) such as those illustrated in Figure 1.

Some of the factors used for determining the number of shop classrooms or instructional areas needed are the enrollment in industrial arts, the number of shops/laboratories or classes, the type of courses, the amount of group instruction given, and the degree to which audiovisual instructional material is used.

In cases where shop/laboratory classrooms or instructional areas illustrated in Figure 1 cannot be provided, consideration should be given to where the teacher will meet his class to give group instruction in the open shop/laboratory area.



Industrial arts instruction is conducted in separate classrooms, alcoves, or areas in the open shops/laboratories in the Los Angeles Unified School District. In this particular facility, an alcove serves as the instructional area. The drape (at right) can be drawn to darken area for showing films, slides, and transparencies.

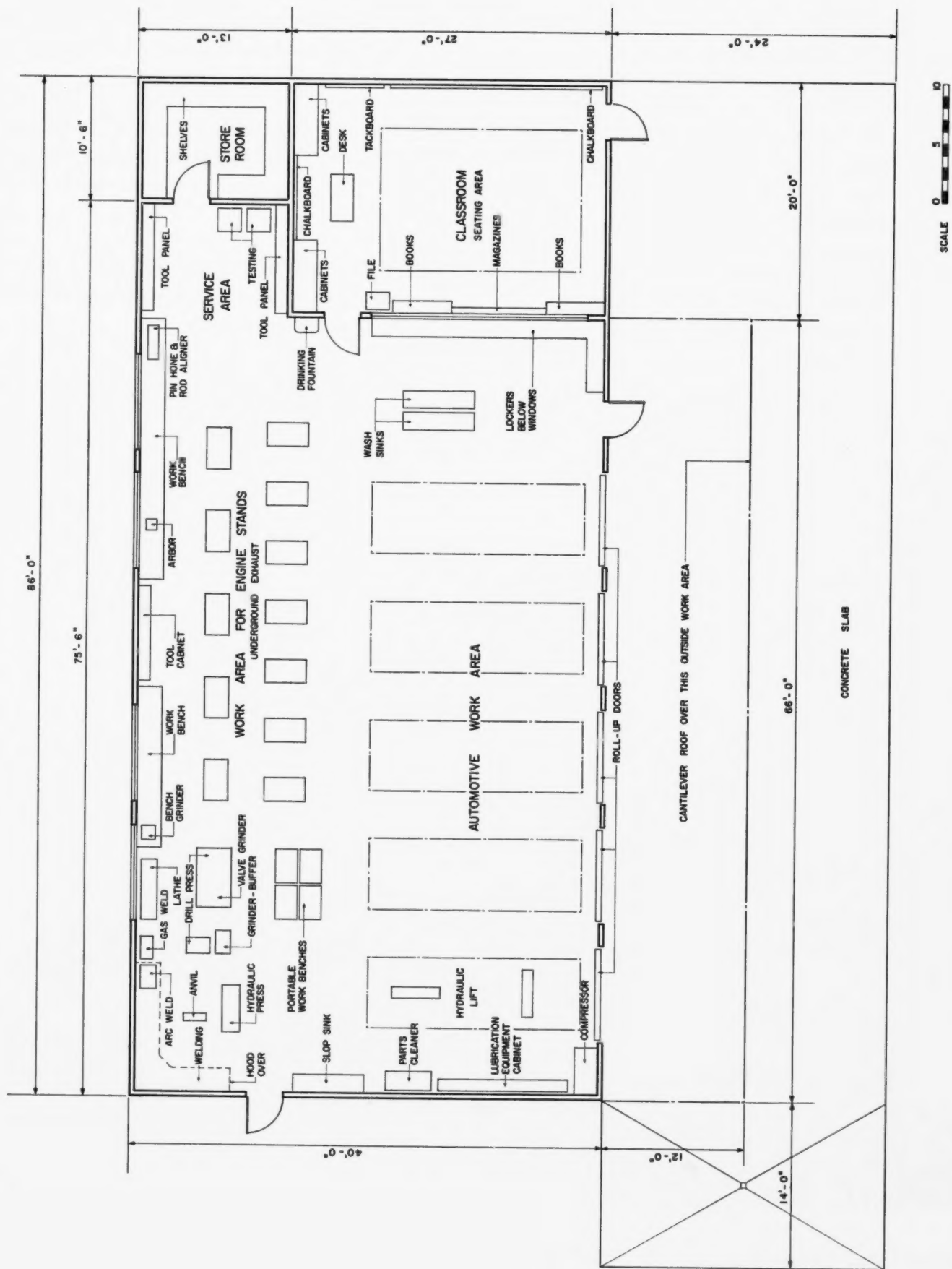


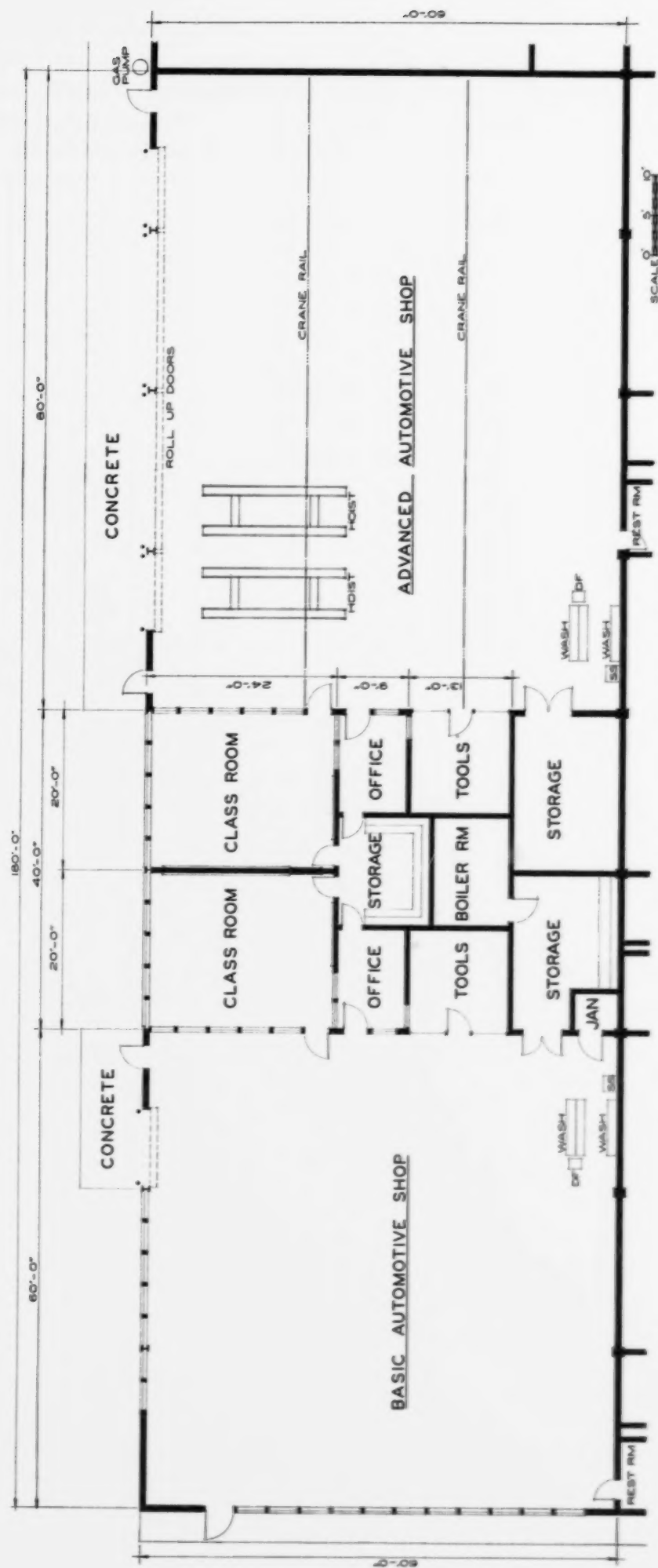
Figure 2. Industrial Arts Automotive Mechanics Facility
Designed for Automotive Mechanics Courses for Grades Nine Through Twelve or Ten Through Twelve

TABLE 1

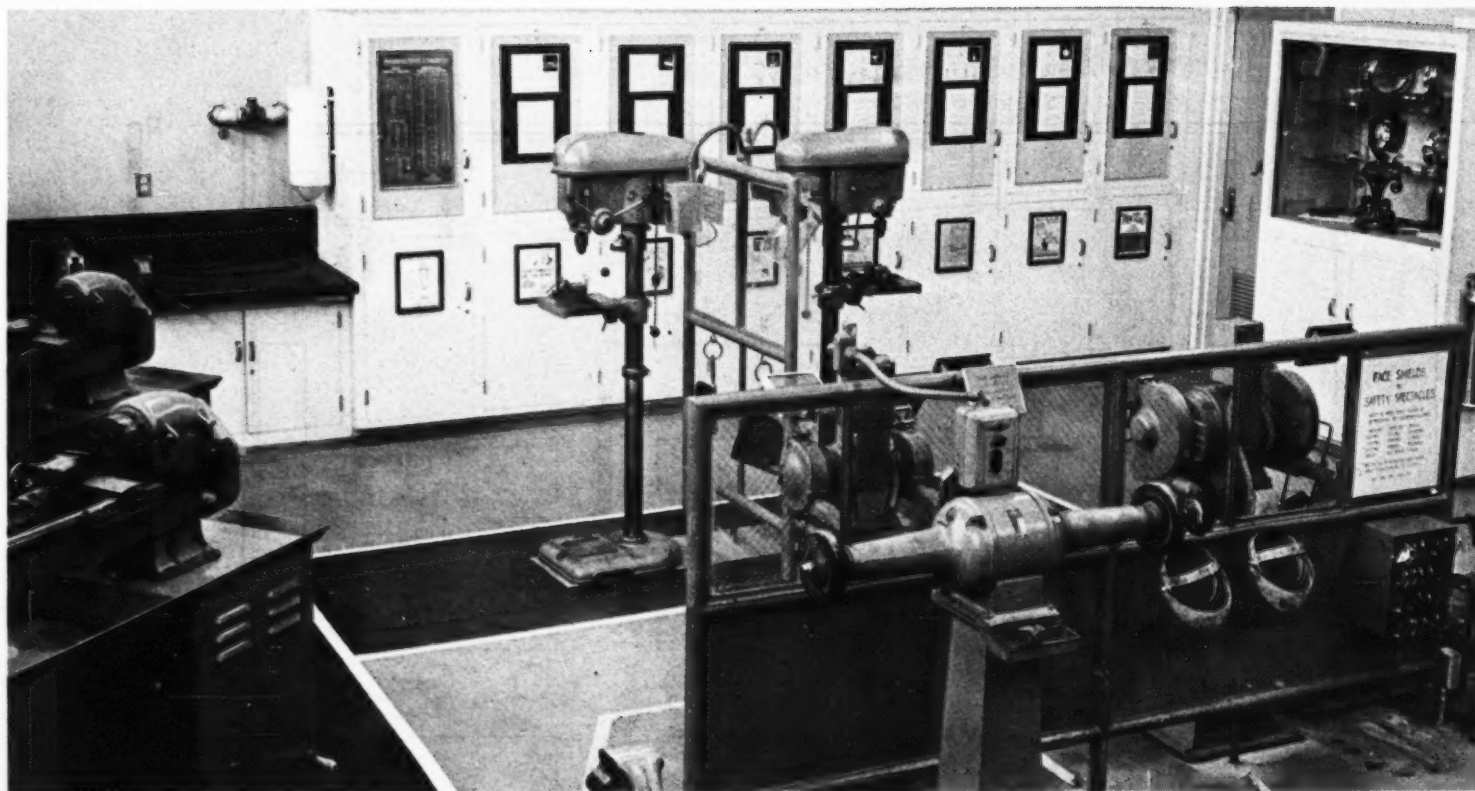
**Major Kinds and Quantities of Equipment Provided in the Industrial Arts Automotive Mechanics Facilities
for Grades Nine Through Twelve or Ten Through Twelve of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Aligner, rod	1	-	1	1	1	1	1	1	1	1
Anvil	1	-	1	-	1	1	-	1	-	1
Balancer, wheel	1	1	1	1	1	1	1	1	1	1
Boring bar, cylinder	-	-	1	1	1	-	1	1	-	1
Charger, battery	1	1	1	2	1	2	1	2	1	1
Cleaner, parts	1	1	1	1	1	1	1	1	1	1
Cleaner, spark plug and adapters	1	1	1	1	1	1	1	1	1	1
Compressor, air	1	1	1	1	1	1	1	1	1	1
Drill, electric, portable	2	2	2	2	2	2	2	2	2	2
Drill press, bench	-	1	1	-	1	-	-	1	1	1
Drill press, floor	1	1	-	1	1	1	1	1	-	1
Engine, automotive	6	4	6	14	12	8	6	6	1	6
Furnace, soldering	2	1	1	1	2	2	1	1	-	1
Grinder	2	1	1	2	1	1	1	1	1	2
Grinder and buffer	1	1	1	-	1	-	1	1	3	1
Grinder, valve refacer	1	1	1	1	1	1	1	1	1	1
Grinder, valve seat	1	1	1	1	1	1	1	1	1	1
Gun, chassis grease	1	1	1	1	1	1	1	1	1	1
Gun, spray	-	1	-	-	2	-	1	1	2	1
Hoist, chain	-	1	1	1	2	1	-	1	1	1
Hone, cylinder	1	1	1	1	1	1	1	1	1	1
Hone, pin	-	1	1	-	1	1	1	1	-	1
Jack, hydraulic, car	2	2	2	2	4	3	4	2	3	4
Lathe, metalworking	1	-	1	1	1	1	1	1	-	1
Lift, hydraulic, car	1	1	1	1	1	1	1	1	1	1
Motor analyzer	1	1	1	1	1	1	1	1	1	1
Press, arbor	1	1	1	1	1	1	-	1	-	1
Pump, gear lubrication	1	1	1	1	1	1	1	1	1	1
Regulator, air	1	1	2	1	1	1	1	1	1	1
Reliner, brake	-	1	1	1	-	1	1	1	-	1
Tester, distributor	1	1	1	1	1	1	1	1	1	1
Tester, generator, regulator	1	1	1	1	1	1	1	1	1	1
Tester, headlight	-	-	1	1	1	1	1	1	1	1
Tester, spring	-	1	1	1	1	1	1	1	1	1
Torch, gas, preheating	-	-	1	-	1	-	1	1	2	-
Vise, bench, machinist's	10	4	6	7	6	8	6	4	6	8
Vise, piston pin	-	-	1	-	1	3	-	1	-	1
Welding, arc, vertical unit	-	1	-	-	1	1	1	1	1	1
Welding, gas, unit	1	1	1	-	1	1	1	1	2	1

*Certain of the districts also provide the following equipment: changer, tire; gauge set, wheel aligning; jack, transmission; lathe, brake drum; lift, portable, pneumatic; reconditioning tool, armature; tester, armature; tester, battery; and wrench, impact, air.



Two automotive mechanics shops/laboratories, one for beginning courses and the other for advanced courses, are provided in the industrial arts building at Delano High School. Each facility has a separate classroom. The architectural work was done by the firm of C. B. Alford and W. J. Thomas, Bakersfield.



A wire-glass shield between the buffer and grinder protects students but does not obstruct the teacher's view of the entire shop/laboratory.



Shadow-free artificial lighting and modern equipment in a drafting facility enhance the learning potential of the students.

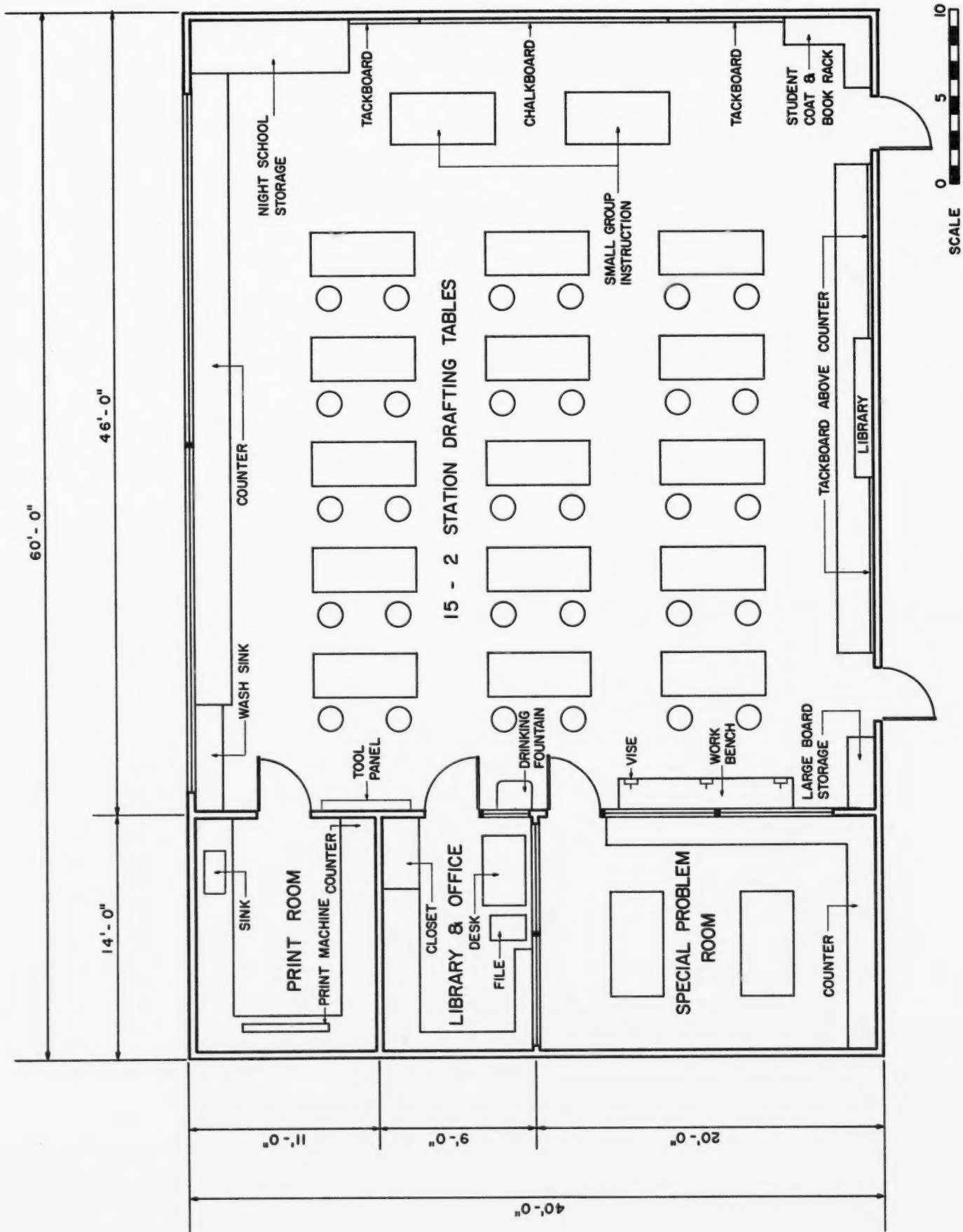


Figure 3. Industrial Arts Drafting Facility
Designed for Drafting Courses for Grades Seven Through Twelve

TABLE 2

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts Drafting
Facilities for Grades Seven and Eight or Seven Through Nine
of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Board, drawing	160	180	144	30	36	180	-	150	48	180
Cutter, paper	1	1	1	1	1	1	1	1	-	1
Instruments, drawing, set	-	32	36	1	2	30	4	-	24	-
Lettering set	1	-	-	1	1	1	1	1	2	1
Machine, drafting	1	1	-	1	-	-	1	-	-	-
Machine, reproduction	1	1	1	1	-	1	-	1	-	1
Stool	32	30	30	31	30	30	30	30	-	30

Table, drafting (1- or 2-station) – Generally 30 student stations per facility

*Certain of the districts also provide the following equipment: dispenser, Ozalid paper; easel; and holder, chart.

TABLE 3

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts Drafting
Facilities for Grades Nine Through Twelve or Ten Through Twelve
of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Board, drawing	150	180	180	30	180	180	-	150	150	180
Cutter, paper	1	1	1	1	1	1	1	1	1	1
Instruments, drawing, set	6	32	36	1	12	1	-	30	150	1
Lettering set	2	1	1	2	2	1	1	2	6	1
Machine, drafting	1	2	1	30	1	1	15	9	3	1
Machine, reproduction	1	1	1	2	1	1	1	1	1	1
Stool	30	32	30	31	30	30	30	30	35	30
Table, drafting (large)	4	-	-	1	-	-	1	-	1	-

Table, drafting (1- or 2-station) – Generally 30 student stations per facility

*Certain of the districts also provide the following equipment: brush, air; cabinet, drafting; dispenser, Ozalid paper; divider, proportional; easel; and eraser, electric.

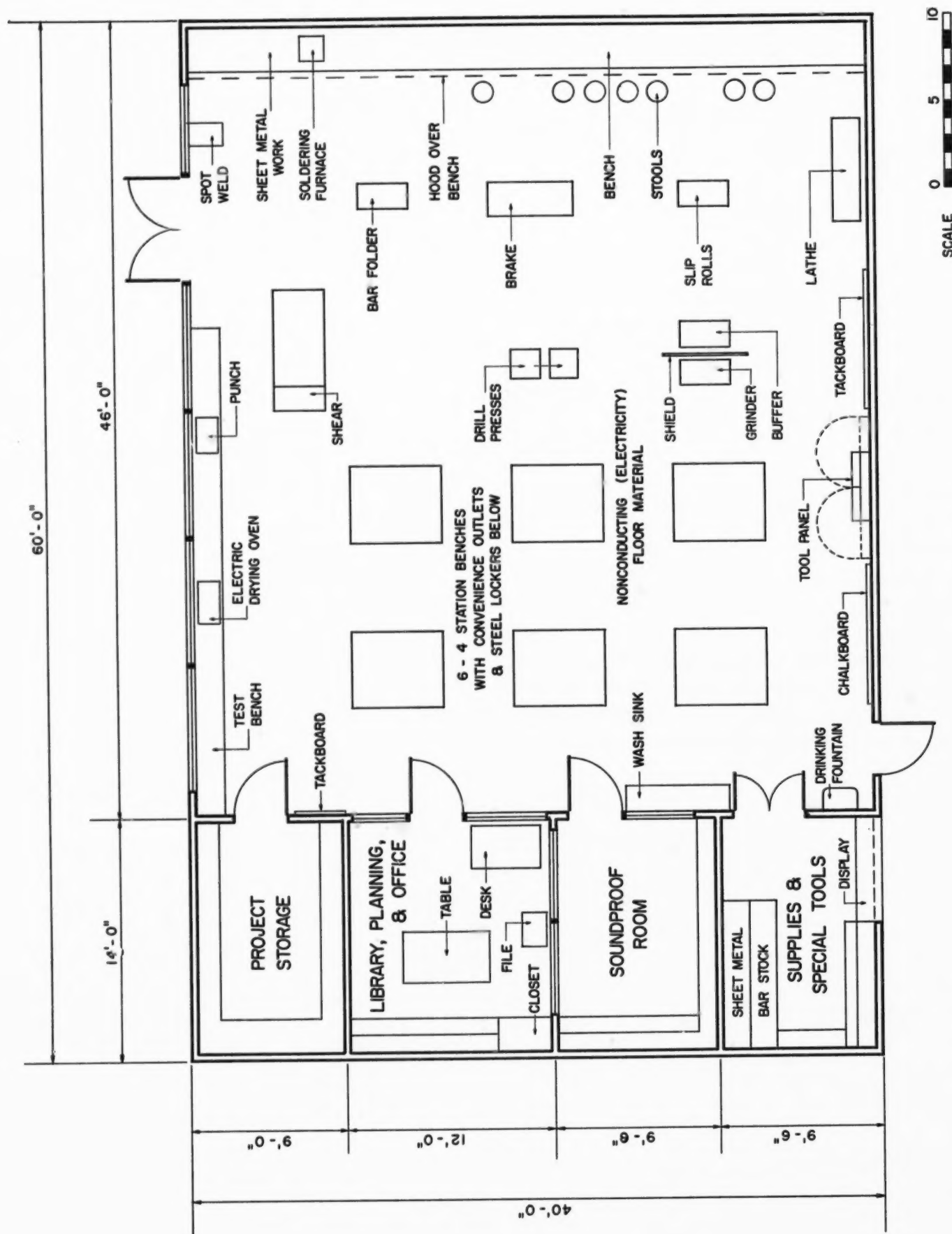


Figure 4. Industrial Arts Electricity/Electronics Facility
Designed for Electricity/Electronics Courses for Grades Seven and Eight or Seven Through Nine

TABLE 4

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Electricity/Electronics Facilities for Grades Seven and Eight
or Seven Through Nine of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Anvil	1	-	1	-	1	-	-	1		
Brake, box and pan	1	1	1	1	1	1	1	1		
Buffer, pedestal	-	1	-	-	1	1	-	1		
Charger, battery	-	1	-	-	1	-	1	-		
Drill, electric, portable	1	1	-	1	2	1	2	-		
Drill press, bench	-	1	1	-	1	1	-	-		
Drill press, floor	2	-	-	1	1	-	1	1		
Folder, bar	-	-	1	-	1	-	-	1		
Furnace, soldering	1	1	7	-	2	1	1	1		
Generator, signal	1	2	-	2	-	1	1	-		
Grinder, pedestal	1	1	1	1	1	1	1	1		
Lathe, metalworking	1	-	-	-	1	-	-	-		
Oscilloscope	1	1	14	6	-	1	-	-		
Punch, metal	3	1	1	-	1	1	1	-		
Rolls, slip forming	-	-	1	-	-	1	-	1		
Shear, squaring	1	1	1	1	-	1	-	1		
Tester, appliance	1	1	2	1	2	-	-	-		
Tester, tube	1	1	1	1	-	1	1	-		
Transmitter-receiver	1	1	1	-	-	1	-	-		

Bench (4-station or more) – Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, teacher's demonstration; demonstrator, radio; eliminator, battery (transistor equipment); gun, soldering; meter (ammeter, galvanometer, milliammeter, signal tracer, transistor analyzer, and voltmeter); power supply, installed; power supply, portable; transformer, isolation; welder, spot; and winder, coil.

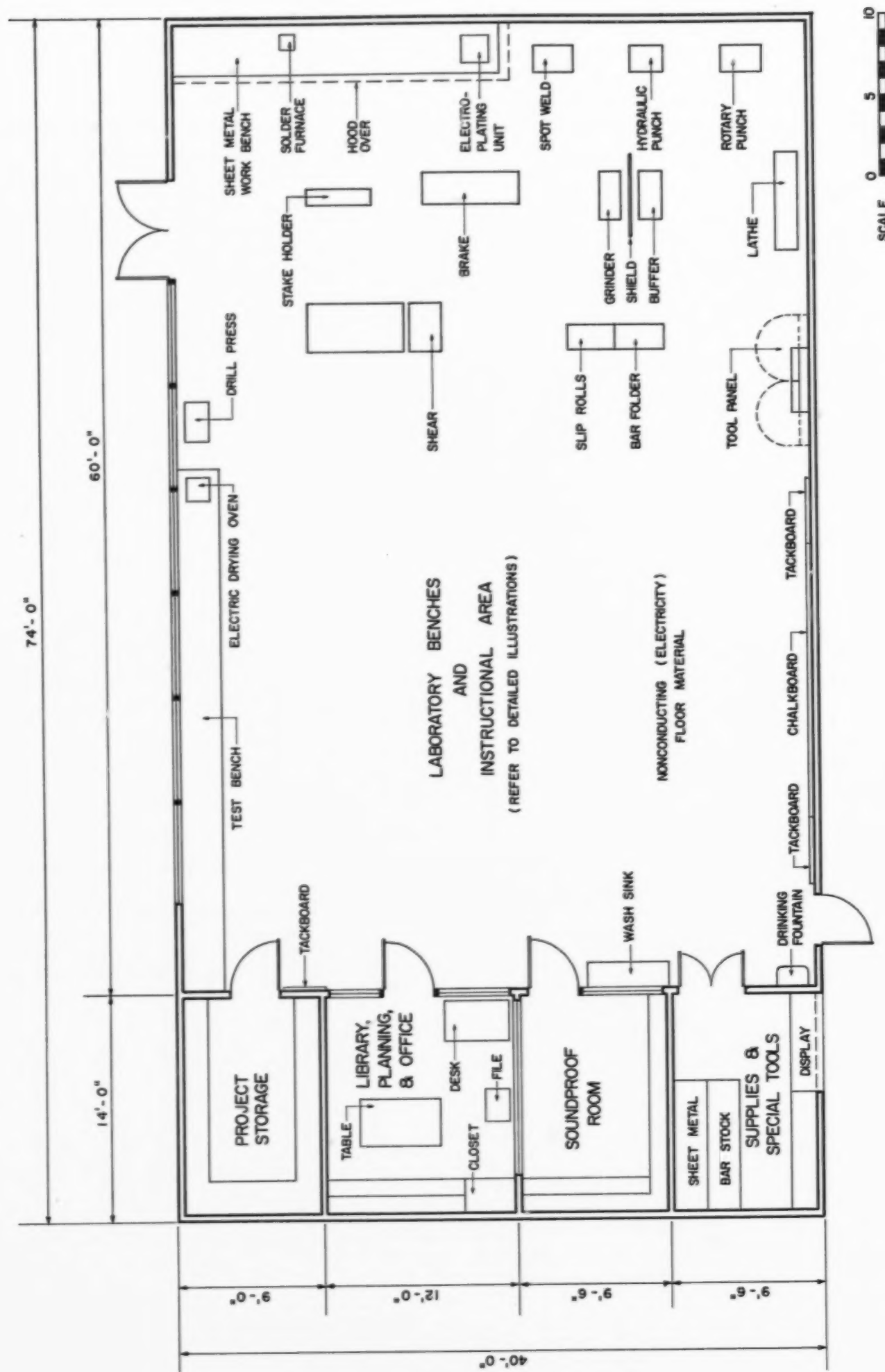


Figure 5. Industrial Arts Electronics Facility
Designed for Electronics Courses for Grades Nine Through Twelve or Ten Through Twelve

TABLE 5

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Electronics Facilities for Grades Nine Through Twelve or Ten
Through Twelve of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Anvil	.	.	1	.	1	1	.	1	.	.
Brake, box and pan	1	1	1	1	1	1	1	1	1	1
Brazing, soldering, annealing unit	.	.	1	.	1	.	1	1	.	.
Buffer, pedestal	.	1	1	1	1	1	1	1	.	.
Charger, battery	1	1	1	.	1	.	1	1	.	.
Drill, electric, portable	1	1	1	1	2	1	1	2	1	1
Drill press, bench	1	1	1	.	1	1	.	1	1	1
Drill press, floor	1	.	.	1	1	.	1	1	.	.
Folder, bar	.	1	1	1	1	1	1	1	.	.
Furnace, soldering	.	1	3	.	2	2	1	1	.	2
Generator, signal	2	2	1	15	2	3	2	2	4	1
Grinder, pedestal	1	1	1	1	1	1	1	1	1	1
Lathe, metalworking	1	.	1	.	1	.	.	.	.	.
Oscilloscope	4	4	14	15	2	2	2	2	10	4
Oven, electric, drying	.	.	1	.	1	.	1	.	.	.
Punch, metal	2	2	1	.	1	3	1	1	.	1
Rolls, slip forming	.	.	1	.	.	1	1	.	.	.
Shear, squaring	1	.	1	1	1	1	1	1	1	.
Stake plate, mounted	.	.	1	.	.	.	.	.	.	.
Stakes	.	.	6	.	.	.	.	3	.	.
Tester, appliance	1	1	1	.	3	.	.	1	.	.
Tester, tube	2	1	1	3	1	2	2	2	2	1
Transmitter-receiver	1	1	1	1	2	1	1	1	1	1

Bench (2-station or more) – Generally 24 student stations per facility

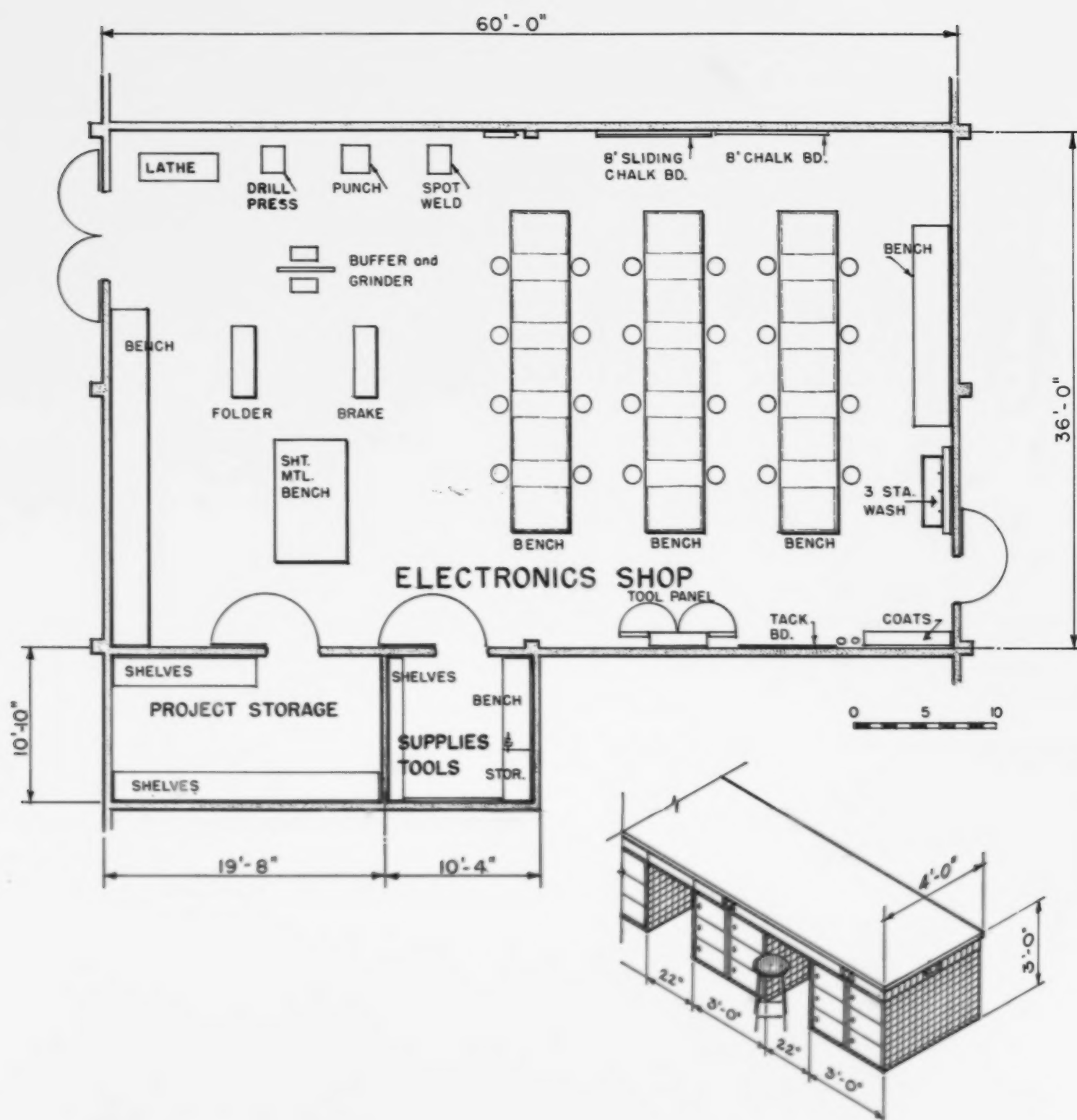
*Certain of the districts also provide the following equipment: amplifier (preamplifier); bench, electric test; bench, sheet metal; bench, teacher's demonstration; calibrator, crystal; eliminator, battery (transistor equipment); generator, sweep and mark; gun, soldering; meter (ammeter, capacitor, analyzer, galvanometer, milliammeter, multimeter, signal tracer, TV analyzer, transistor analyzer, and voltmeter); power supply, installed; power supply, portable; transformer, isolation; welder, spot; and winder, coil.



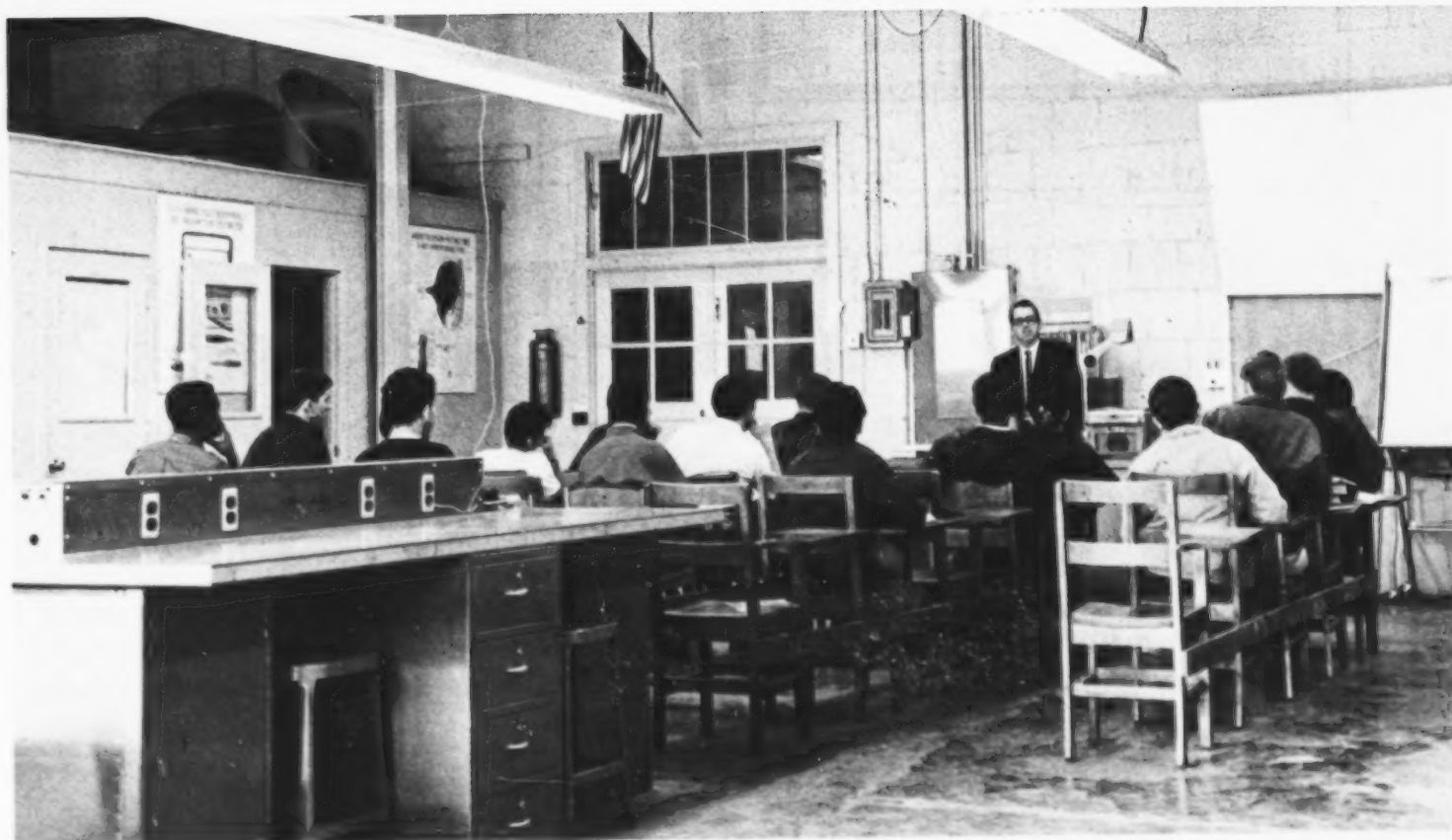
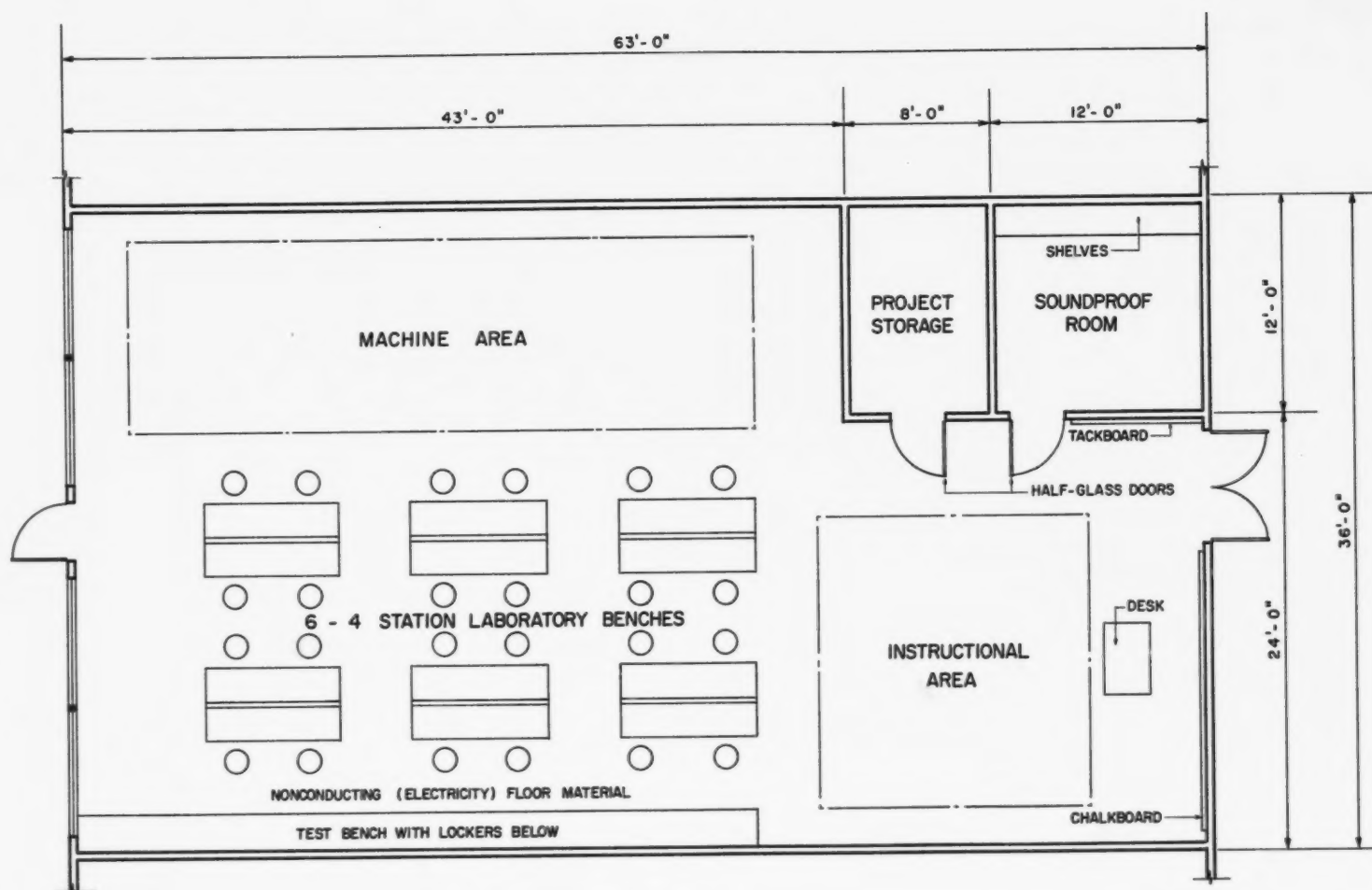
Four-station workbenches and test benches with steel lockers underneath, an instructional area (alcove), and a soundproof room with windows to assist the teacher in supervision are among the requirements for an electricity/electronics facility for grades seven and eight or seven through nine.



Three counter-height laboratory benches, each accommodating eight students, are provided in the electronics facility at Seaside High School in the Monterey Peninsula Unified School District. Each bench has a replaceable counter top with power outlets located under the edges. Knee-hole space is furnished at each student station between the banks of steel lockers (refer to floor plan, equipment layout, and detailed drawing of bench on next page).



These illustrations show the floor plan and equipment layout of the electronics shop/laboratory and a detailed drawing of an electronics bench located in the Seaside High School industrial arts building. The architectural work was done by the firm of Fred Keeble and George Rhoda, Monterey.



This drawing and photograph illustrate the use of the open shop/laboratory area for group instruction, as well as bench and machine activities, in the electronics facility at Sacramento High School.

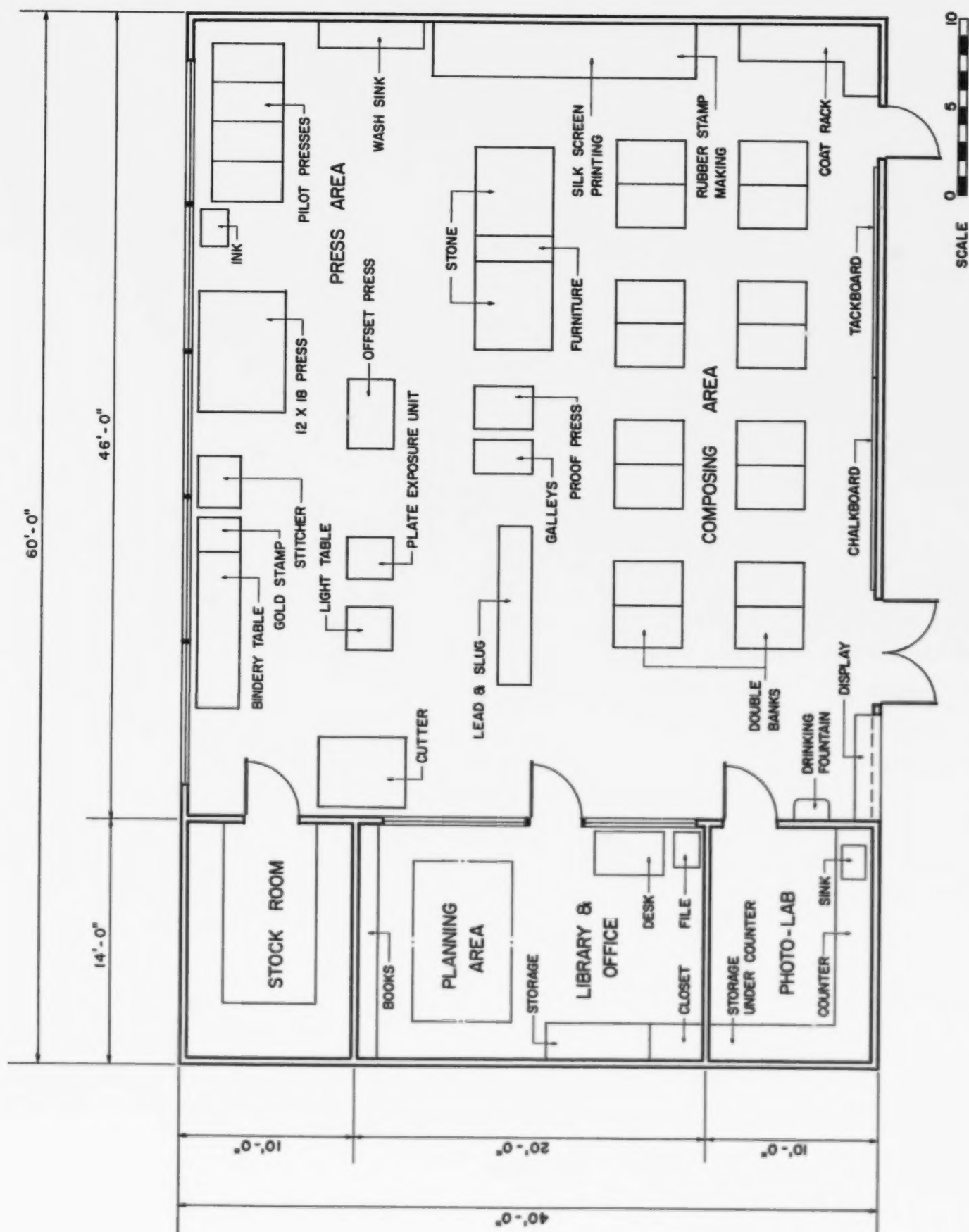


Figure 6. Industrial Arts Graphic Arts Facility
Designed for Graphic Arts Courses for Grades Seven and Eight or Seven Through Nine

TABLE 6

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Graphic Arts Facilities for Grades Seven and Eight or Seven
Through Nine of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Bank (double)	12	4	8	10	10					
Bindery table	1	1	1	2	2					
Chase rack	1	1	1	1	1					
Cutter, guillotine	1	1	1	1	-					
Cutter, hand lever	1	1	1	1	1					
Cutter, slug and lead	1	1	1	1	1					
Goldstamping press	1	-	1	1	1					
Imposing stone	1	1	1	1	1					
Ink cabinet	1	1	1	1	-					
Machine, mitring	1	-	1	1	1					
Machine, numbering	4	1	2	2	2					
Press, bookbinder's	1	1	1	1	2					
Press, hand	3	1	2	2	4					
Press, power platen	2	1	2	2	2					
Press, proof	1	1	1	1	2					
Press, rubberstamp	1	-	1	1	1					
Rack, leads and slugs	1	1	8	1	10					
Rack (with reglets)	1	1	-	1	1					
Rack (with wood furniture)	1	1	-	1	1					
Silk screen unit	1	4	1	1	1					
Stapler, foot	-	1	1	1	1					

*Certain of the districts also provide the following equipment: bench, teacher's demonstration; camera; dryer (photography); easel (photography); enlarger; exposure unit, plate; machine, paper drilling; machine, folding; perforator, hand; punch, hand; press, offset; printer, contact; stitcher, wire; table, light; table, stripping; timer (photography); and washer (photography).



The graphic arts facility for grades seven and eight or seven through nine includes equipment for hand composition, letterpress printing, and binding.

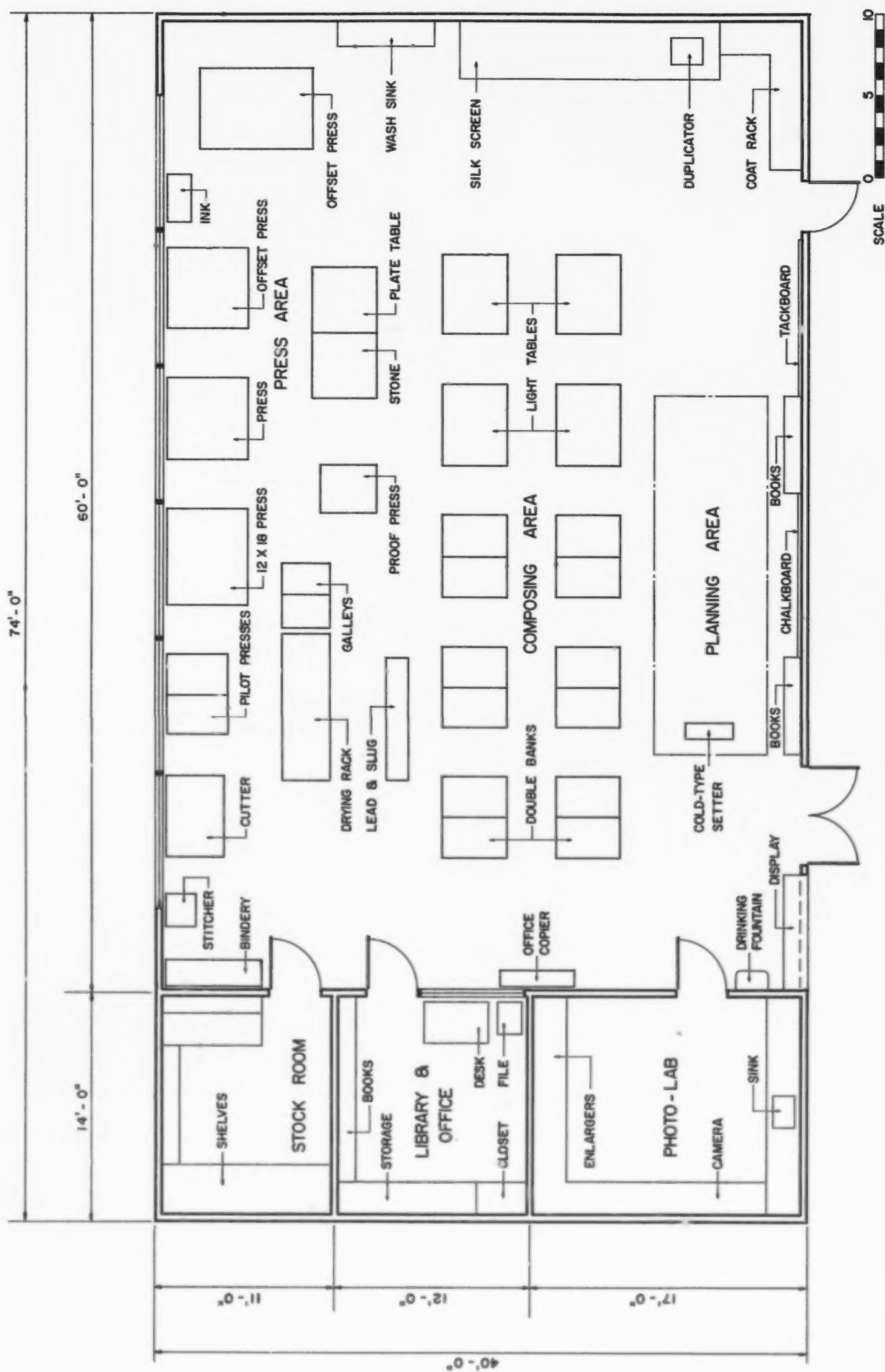


Figure 7. Industrial Arts Graphic Arts Facility
Designed for Graphic Arts Courses for Grades Nine Through Twelve or Ten Through Twelve

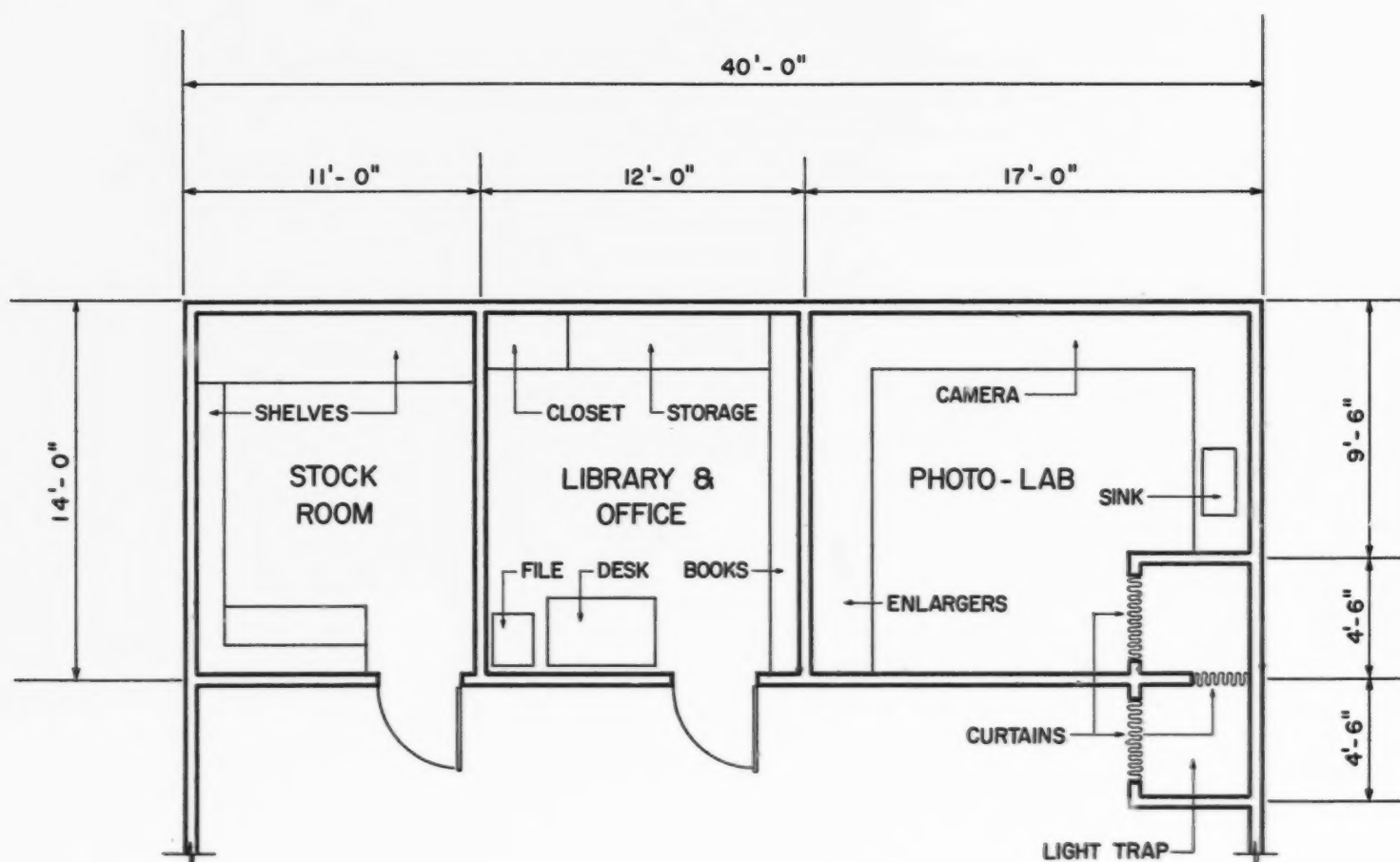


Figure 7A. Light Trap That May Be Used at Entrance-Exit of Photography Laboratory in the Graphic Arts Facility (Figure 7)



Graphic arts facilities in the high schools of the San Diego City Unified School District make provision for both offset lithography and letterpress printing.

TABLE 7
Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Graphic Arts Facilities for Grades Nine Through Twelve or Ten
Through Twelve of Selected School Districts*

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Bank (double)	4	5	8	6	10	-	6		8	10
Bindery table	-	1	1	2	2	1	2		-	1
Camera	-	6	-	1	-	6	1		-	-
Chase rack	1	1	1	1	2	8	1		-	3
Cutter, guillotine	1	1	1	1	-	1	1		1	1
Cutter, hand lever	1	1	1	-	1	1	1		1	1
Cutter, slug and lead	1	1	1	1	1	1	1		1	1
Enlarger	-	4	-	-	-	2	1		1	-
Exposure unit, plate	1	1	-	1	-	-	1		-	-
Goldstamping press	-	-	1	1	1	1	1		1	-
Imposing stone	1	1	1	1	1	1	1		1	2
Ink cabinet	1	1	1	1	-	1	1		-	2
Machine, mitering	1	1	1	1	1	-	1		-	1
Machine, numbering	1	1	2	2	2	1	2		2	1
Machine, type casting	2	-	-	1	1	-	1		-	2
Offset camera	-	1	-	1	-	1	1		-	-
Offset developing unit	-	1	-	1	-	1	1		-	-
Press, bookbinder's	-	1	1	2	2	3	-		1	1
Press, hand	1	2	2	-	3	1	2		3	1
Press, offset	2	2	-	1	-	1	2		1	1
Press, power platen	2	2	2	6	3	3	2		2	2
Press, proof	2	1	1	1	2	2	1		1	2
Press, rubberstamp	1	-	1	1	1	-	1		1	-
Punch, hole	-	1	-	1	1	1	1		-	1
Rack, leads and slugs	2	1	-	1	10	1	2		4	3
Rack (with reglets)	1	1	-	1	1	1	1		-	2
Rack (with wood furniture)	1	1	-	1	2	1	1		-	2
Silk screen unit	1	9	1	6	2	3	1		-	-
Smelter, lead	1	-	-	1	-	-	-		-	1
Stapler, manual/power	1	1	1	1	1	-	1		1	1
Stitcher, wire	1	-	-	1	-	-	1		-	1

*Certain of the districts also provide the following equipment: bench, teacher's demonstration; cabinet, galley; cabinet, strip material; dryer (photography); easel (photography); frame, padding; machine, folding; machine, paper drilling; perforator, power; press, cylinder; rack, drying; saw, trimming; stereotype equipment; table, imposing; table, layout; table, light; table, make-up; table, stripping; timer (photography); and washer (photography).

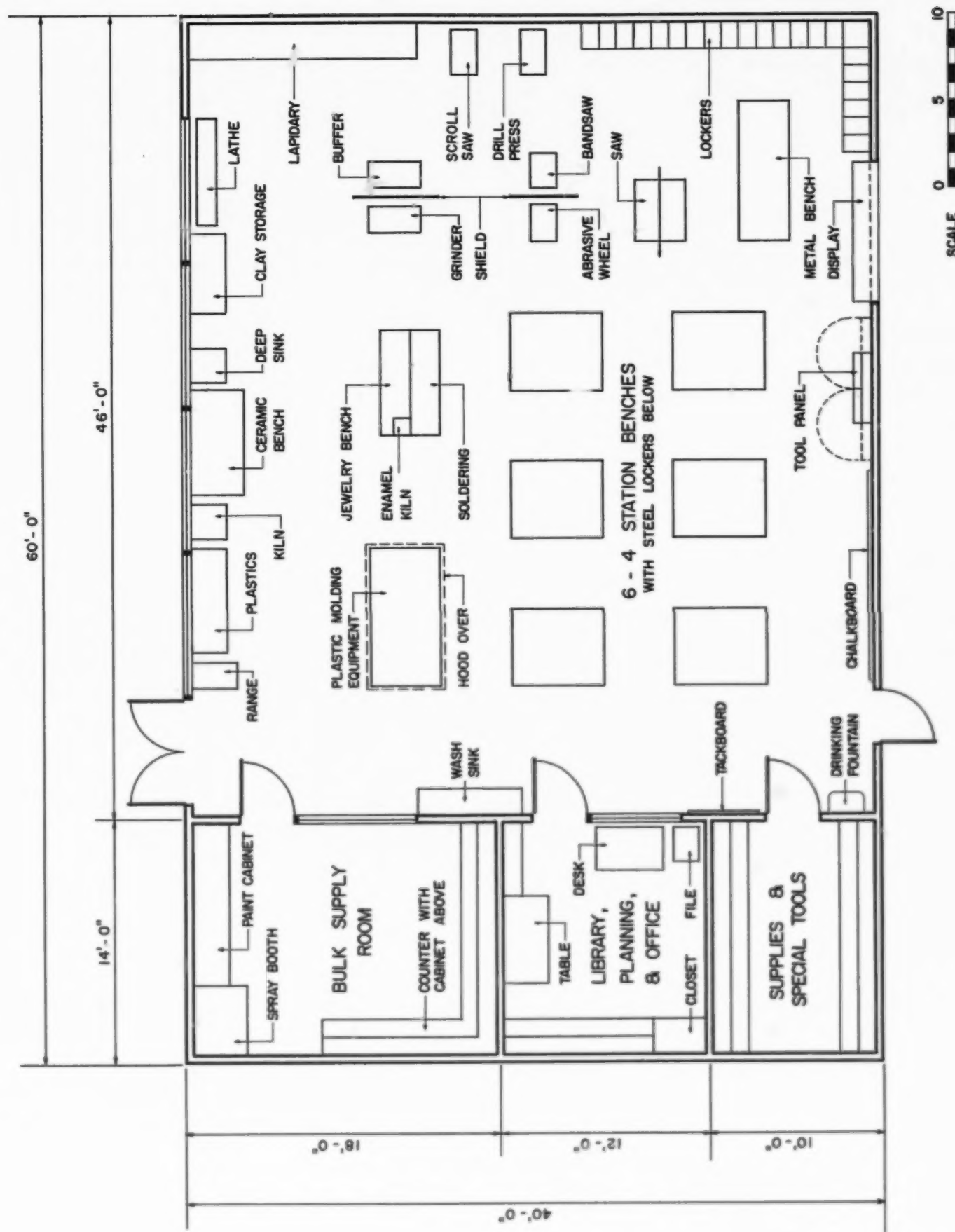


Figure 8. Industrial Arts Industrial Crafts Facility
Designed for Industrial Crafts Courses for Grades Seven Through Twelve

TABLE 8

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Industrial Crafts Facilities for Grades Seven Through Twelve
of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Anvil	2			4	-	1	-	1	1	
Buffer	2			1	2	4	2	2	3	
Compressor, air	-			-	1	1	1	-	-	
Damp box, ceramics	-			-	1	1	1	-	-	
Drill, electric, portable	-			-	-	1	1	1	1	
Drill press	1			1	1	1	1	1	1	
Furnace, soldering	-			-	-	2	1	1	2	
Grinder	1			-	1	2	2	1	1	
Gun, spray	-			-	1	-	1	-	1	
Kiln, ceramics	-			-	3	1	2	-	-	
Kiln, electric	1			1	2	1	1	2	1	
Lapidary unit	-			-	1	-	1	1	1	
Lathe, wood/metal spinning	-			-	-	1	1	-	1	
Oven, plastic forming	1			-	1	1	1	1	1	
Potter's wheel	-			-	5	1	2	-	-	
Regulator, air	1			-	1	1	1	-	2	
Sander, disc	1			1	1	1	1	1	1	
Saw, band (combination wood/metal)	1			-	1	1	1	1	1	
Saw, circular	1			-	1	1	1	1	-	
Saw, scroll	1			1	1	1	1	1	1	
Spray booth	-			-	1	-	1	-	1	
Tool, carving and grinding, electric, portable	1			-	-	1	1	2	1	
Torch, soldering unit	1			-	3	1	1	1	2	

Bench (4-station) — Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, metal top; bench, teacher's demonstration; collector, dust; cutter, paper; hot plate, electric; hot plate, gas; machine, centrifugal casting; machine, sewing; machine, vacuum forming; miter box; press, printing; sander, portable, belt; stakes, set; and storage unit, clay.

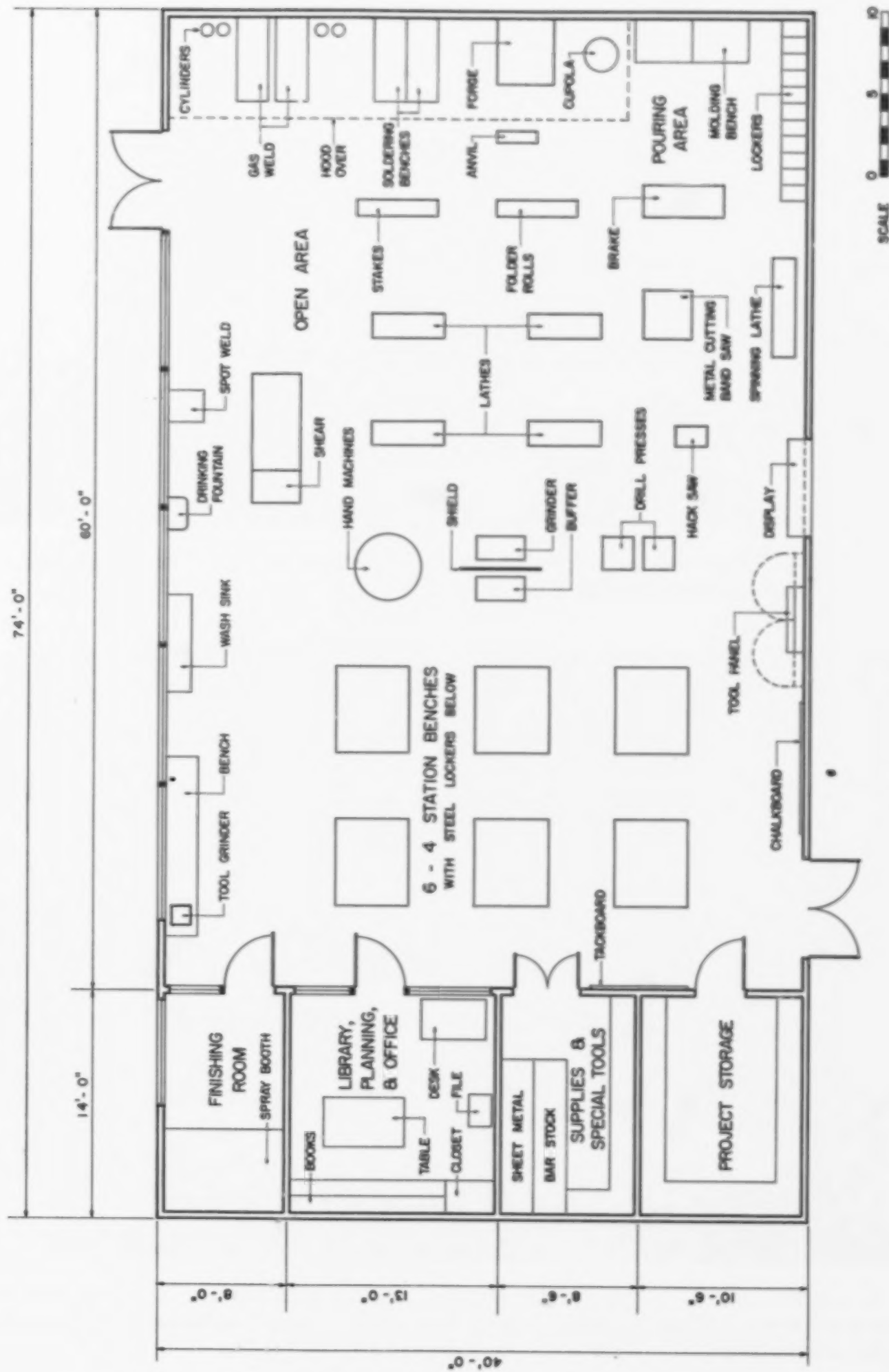
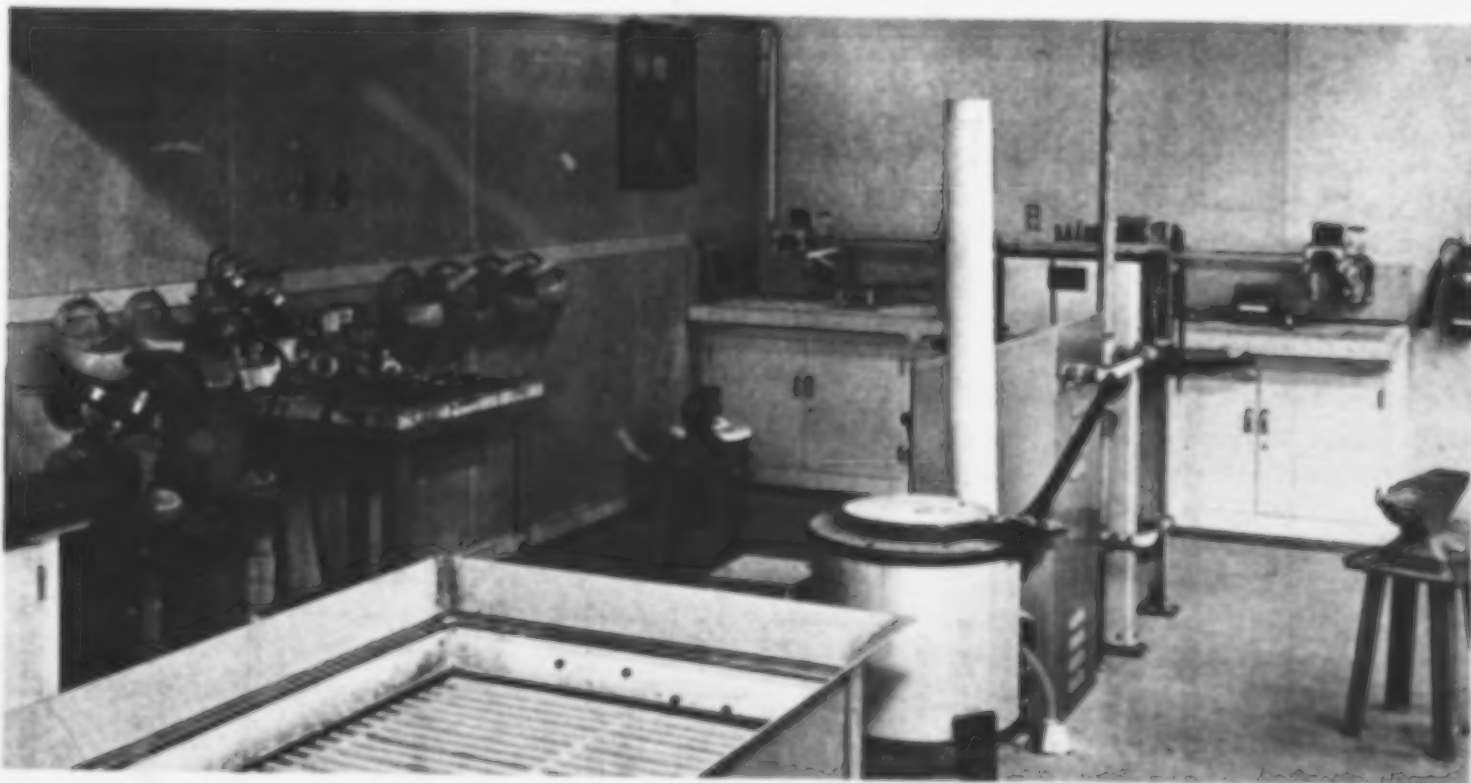


Figure 9. Industrial Arts Metals Facility
Designed for Metals Courses for Grades Seven and Eight or Seven Through Nine



Casting, forging, soldering, and welding are important elements of the metals courses designed for grades seven and eight or seven through nine.



In a metals facility, students acquire extensive knowledge and skills through the use of tools and machines in art metal, casting, finishing, forging, heat treating, metal machining, metal spinning, sheet metal, and welding.

TABLE 9
Major Kinds and Quantities of Equipment Provided in the Industrial Arts
Metals Facilities for Grades Seven and Eight or Seven Through Nine
of Selected School Districts*

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Anvil	5	2	2	4	4	-	1	1	1	4
Band saw, metal cutting	-	-	1	-	-	-	-	1	1	1
Bench, molding	1	1	1	1	1	1	1	-	-	-
Brake, box and pan	1	1	1	1	1	1	1	1	1	1
Buffer	1	1	2	1	1	2	1	1	1	1
Compressor, air	-	1	1	-	1	1	1	-	1	1
Cupola or furnace, pot and crucible	1	1	1	1	1	-	1	-	-	1
Drill, electric, portable	2	1	1	2	1	1	1	1	1	2
Drill press	2	2	2	1	2	1	1	1	2	2
Folder, bar	1	1	1	1	1	1	1	-	1	1
Forge, gas fired	1	1	1	1	2	1	1	-	1	2
Furnace, soldering	4	4	5	2	4	4	4	2	4	3
Grinder, bench	-	1	1	-	1	-	-	1	1	1
Grinder, pedestal	2	-	1	2	1	2	1	-	1	1
Gun, spray	1	1	1	-	-	1	1	-	1	-
Hack saw, power	1	1	1	-	1	-	-	-	1	1
Lathe, metalworking	2	2	5	3	3	1	1	-	-	3
Machine tree	-	-	-	1	1	-	1	-	1	-
Machines, set; hand turning, burring, elbow edging, wiring, crimping and beading	1	1	1	1	1	1	1	-	1	1
Pyrometer	1	-	1	1	1	1	-	-	-	1
Regulator, air	1	1	1	-	-	1	1	-	1	1
Rolls, slip forming	1	1	1	1	1	1	1	1	1	1
Shear, squaring	1	1	1	1	1	1	1	1	1	1
Spray booth	-	1	1	-	-	1	1	-	-	-
Stake plate, mounted	1	1	1	1	1	1	1	-	2	1
Stakes, set	1	1	1	1	1	1	1	-	1	1
Welding unit, gas	1	2	1	1	-	1	1	-	1	1
Welding unit, spot	1	1	1	1	-	1	1	-	1	1

Bench (4-station) - Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, planning; bench, sheet metal; bench, teacher's demonstration; bench, welding; bender, metal/pipe; brake, universal; etcher, electric; kiln, enameling; lathe, metal spinning; press, arbor; sander, belt and disc; saw, scroll; shaper, metalworking; stake holder, universal; and welding unit, arc.

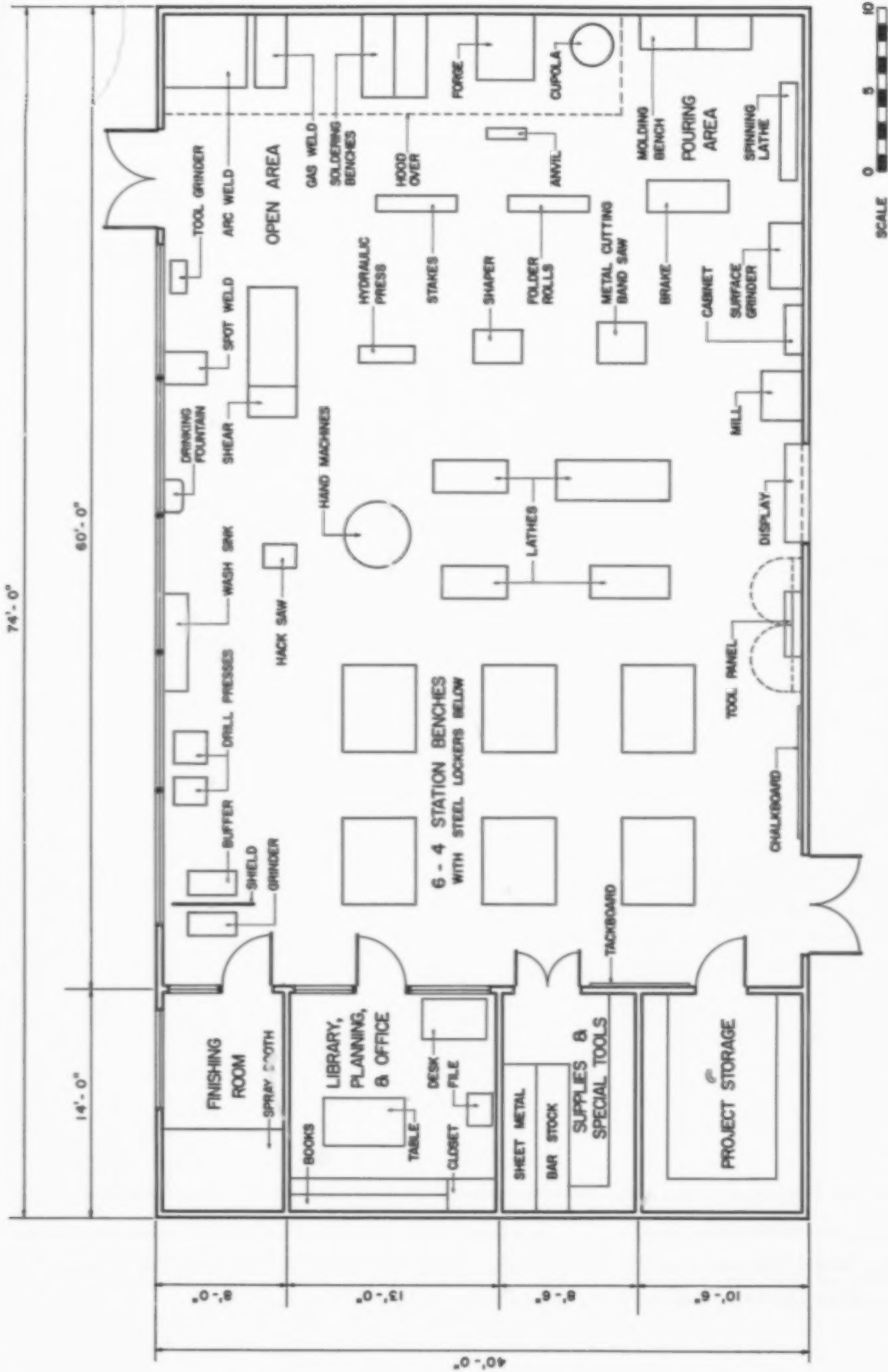


Figure 10. Industrial Arts Metals Facility
Designed for Metals Courses for Grades Nine Through Twelve or Ten Through Twelve

TABLE 10

Major Kinds and Quantities of Equipment Provided in the Industrial Arts Metals Facilities
for Grades Nine Through Twelve or Ten Through Twelve of Selected School Districts*

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Anvil	4	2	2	2	4	3	2	1	2	4
Band saw, metal cutting	-	1	1	-	1	-	1	1	2	1
Bench, molding	2	1	1	1	1	1	2	1	1	1
Bender, metal/pipe	1	1	1	1	1	1	1	1	1	1
Brake, box and pan	1	1	1	1	1	1	1	1	1	1
Buffer	1	1	1	1	1	1	2	1	1	1
Compressor, air	1	1	1	1	1	1	1	1	-	1
Cupola or furnace, pot and crucible	1	1	1	1	1	1	1	1	1	1
Drill, electric, portable	2	1	1	2	2	2	1	2	2	2
Drill press	2	2	2	2	2	1	1	2	2	2
Folder, bar	1	1	1	1	1	1	1	1	1	1
Forge, gas	1	1	1	1	2	1	1	1	1	2
Furnace, soldering	2	3	4	2	4	2	2	1	2	3
Grinder, pedestal	2	2	2	2	1	2	2	2	1	1
Grinder, surface	1	-	-	1	1	-	-	1	-	1
Gun, spray	1	1	1	-	2	1	1	1	1	1
Hack saw, power	1	1	1	1	1	1	1	1	-	1
Lathe, metalworking	4	4	5	5	6	6	2	3	3	4
Lathe, metal spinning	-	-	1	1	-	-	1	-	-	1
Machine tree	-	-	-	1	1	-	1	-	1	1
Machines, set; hand turning, burring, elbow edging, wiring, crimping and beading	1	1	1	1	1	1	4	1	3	1
Milling machine	1	1	1	2	1	1	-	1	-	1
Press, hydraulic	-	1	1	-	1	1	-	1	-	1
Punch, metal	1	-	1	-	1	2	-	1	-	1
Pyrometer	1	-	1	1	1	1	1	1	-	1
Regulator, air	1	1	3	-	1	1	1	1	-	1
Rolls, slip forming	1	1	1	1	1	1	1	1	-	1
Shaper, metalworking	1	-	1	1	1	1	-	1	-	1
Shear, ring and circle	-	1	1	-	1	1	-	1	-	1
Shear, squaring	1	1	1	1	1	1	1	1	1	1
Spray booth	1	1	1	-	-	1	1	1	1	1
Stake plate, mounted	1	1	1	1	1	1	2	-	-	1
Stakes, set	1	1	1	1	1	1	1	1	1	1
Welding unit, arc	1	3	1	2	1	4	2	3	3	1
Welding unit, gas	2	2	1	2	1	7	6	4	6	1
Welding unit, spot	1	1	1	1	1	1	1	1	1	1

Bench (4-station) — Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, planning; bench, sheet metal; bench, teacher's demonstration; bench, welding; brake, universal; etcher, electric; kiln, enameling; machine, material testing; notcher, angle iron; plate, surface; sandblaster; sander, belt and die; saw, scroll; and stake holder, universal.

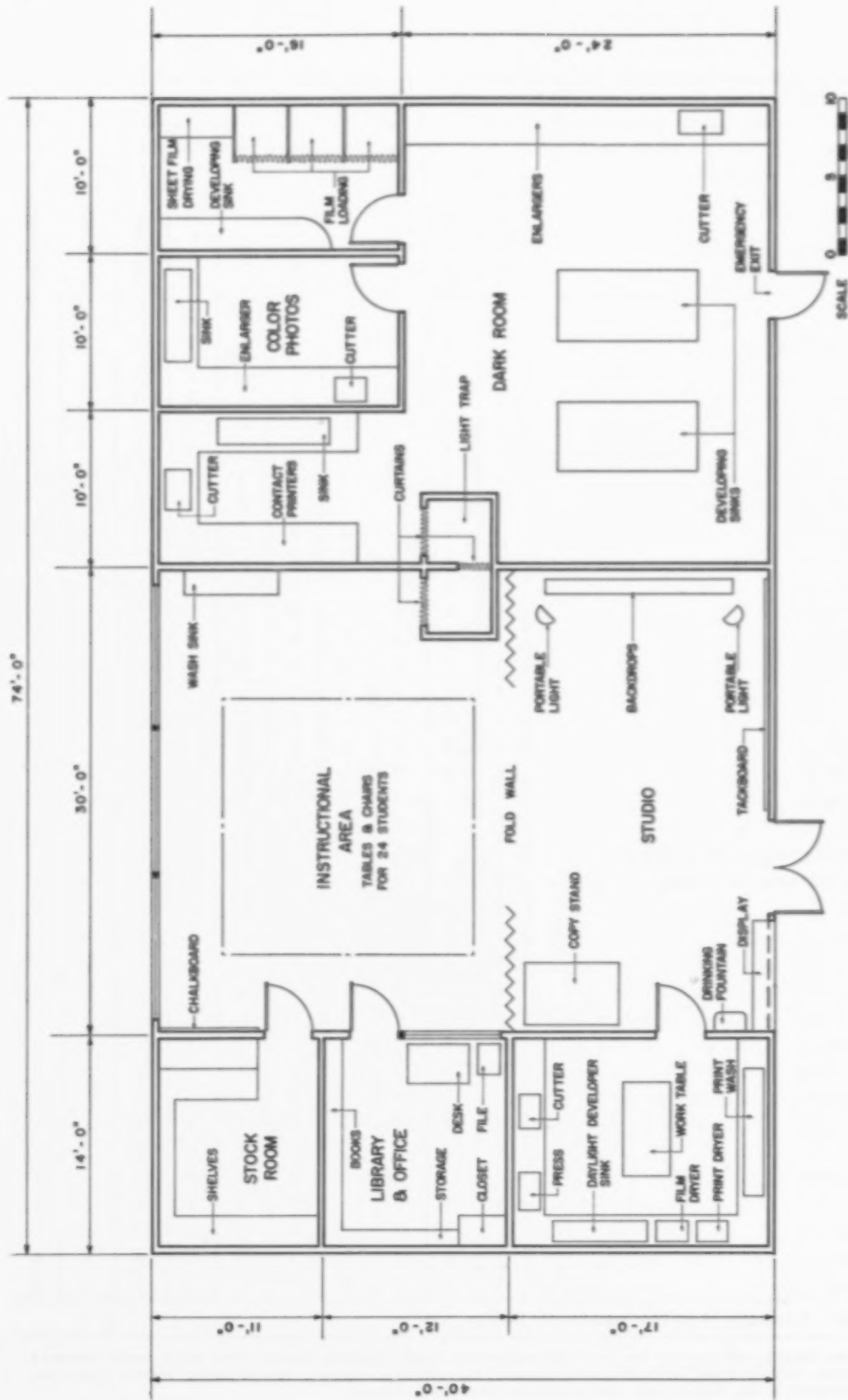


Figure 11. Industrial Arts Photography Facility
Designed for Photography Courses for Grades Nine Through Twelve or Ten Through Twelve

**Major Kinds of Equipment Recommended for Industrial Arts Photography Facilities
for Grades Nine Through Twelve or Ten Through Twelve**

Backdrop
Cameras (box, single lens reflex,
twin lens reflex, press, Polaroid)
Copy stand
Cutter (trimmer)
Dryer, film
Dryer, print
Easel
Enlarger
Hanger, film
Holder, film
Lamp, flood, portable
Lenses

Meter, exposure
Press, dry mount
Printer, contact
Processor, color-print
Refrigerator
Scales
Spotlight, portable
Strobe, electronic
Timer, interval
Timer, print
Tray, fixing
Tripod



A well-equipped photography facility makes it possible for the student to acquire skill in taking various kinds of photographs and producing finished prints.

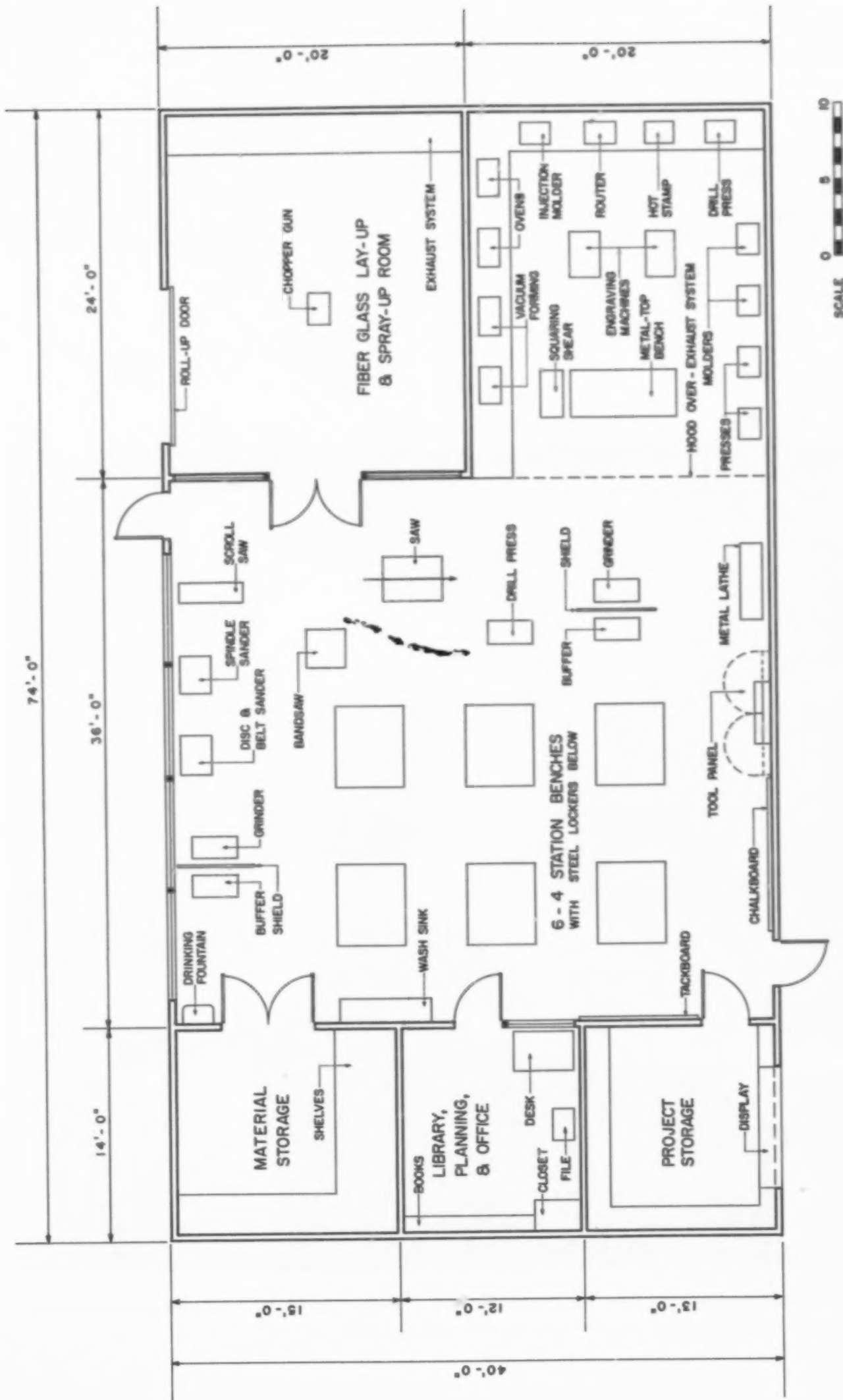


Figure 12. Industrial Arts Plastics Facility
Designed for Plastics Courses for Grades Nine Through Twelve or Ten Through Twelve

**Major Kinds of Equipment Recommended for Industrial Arts Plastics Facilities
for Grades Nine Through Twelve or Ten Through Twelve**

Bench, metal top
Buffer, pedestal
Compressor, air
Drill, electric, portable
Drill press
Grinder, pedestal
Gun, chopper
Gun, spray
Lathe, metalworking
Machine, compression molding
Machine, engraving
Machine, injection molding
Oven, electric
Oven, rotational molding

Press, hot stamp
Press, laminating
Press, vacuum forming
Regulator, air
Router, stationary/portable
Sander, belt and disc
Sander, portable, belt
Sander, portable, orbital type
Sander, spindle
Saw, band
Saw, circular
Saw, scroll
Shear, squaring
Welding unit, plastics

Benches (4-station) — generally 24 student stations per facility



A workbench with an overhead exhaust system is provided in the industrial crafts facility for plastics activities.

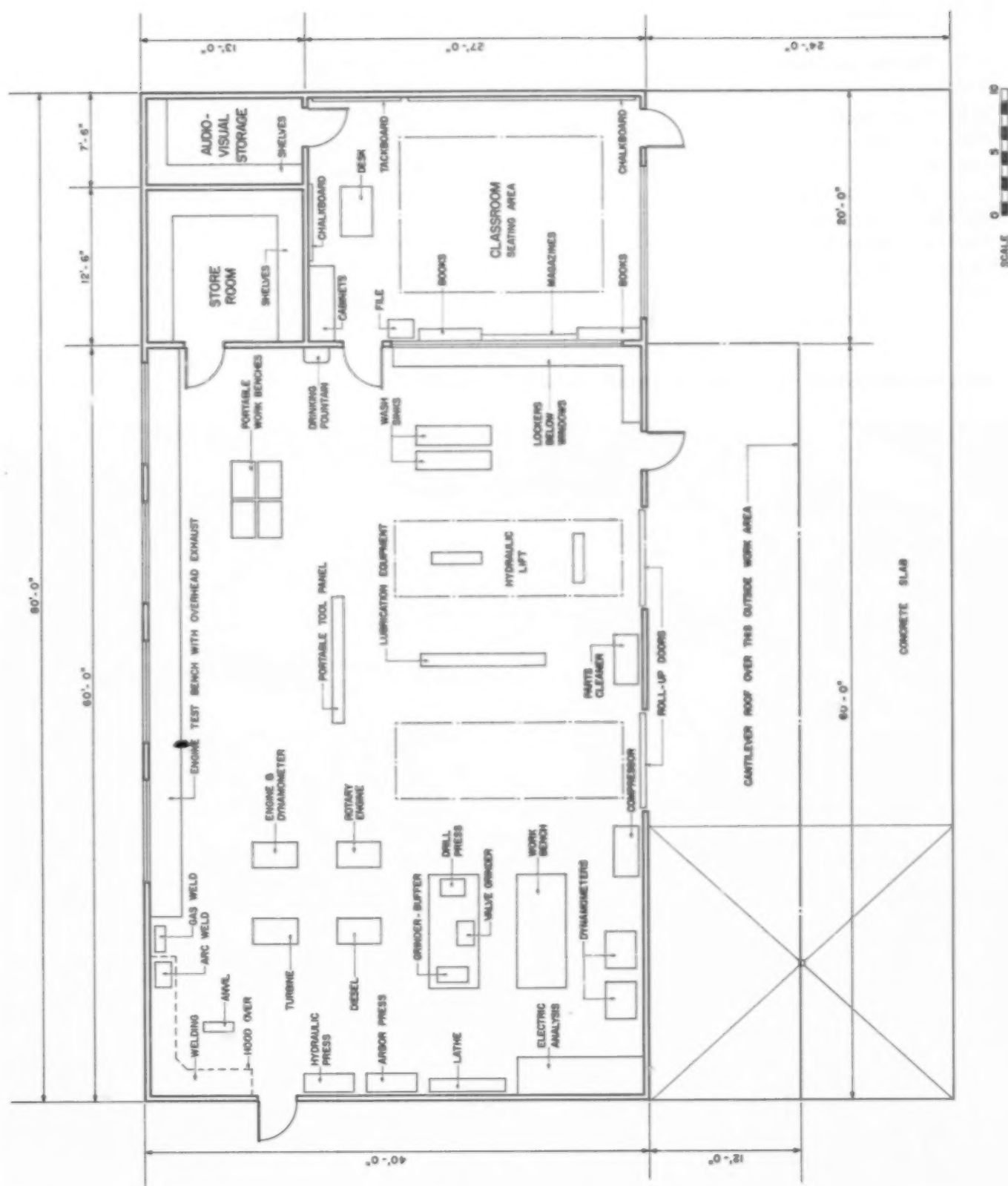


Figure 13. Industrial Arts Power Mechanics Facility Designed for Power Mechanics Courses for Grades Nine Through Twelve or Ten Through Twelve

**Major Kinds of Equipment Recommended for Industrial Arts Power Mechanics
Facilities for Grades Nine Through Twelve or Ten Through Twelve**

Analyzer, automotive engine (with oscilloscope and accessories)	Engine, turbine
Analyzers, engine air flow and fuel flow (small engine and automotive engine)	Grinder, bench
Anvil	Grinder-buffer
Balancer, wheel	Grinder, valve refacer
Charger, battery	Gun, spray
Cleaner, parts	Hoist, engine, portable, hydraulic
Cleaner, spark plug	Hone, cylinder
Compressor, air	Jacks, hydraulic, car
Drill, electric, portable	Lathe, metalworking
Drill press, bench	Lift, hydraulic, car
Dynamometers, engine, portable, hydraulic (small engine and automotive engine)	Lubricating equipment, automotive
Dynamometer, electric motor (disc brake type)	Motors, electric, assorted, fractional horsepower
Engine, gasoline, single cylinder, four-stroke	Press, arbor
Engine, gasoline, single cylinder, two-stroke	Press, hydraulic
Engine, multicylinder, automotive, gasoline	Regulator, air
Engine, multicylinder, automotive, diesel	Stands, automotive engine, portable
Engine, single cylinder, four- stroke, diesel	Tester, distributor
Engine, rotating, combustion	Tester, generator, regulator
	Tester, headlight
	Tester, magneto
	Tester, valve spring
	Tool panel, portable
	Vise, bench, machinist's
	Welding unit, arc, stationary/portable
	Welding unit, gas, stationary/portable

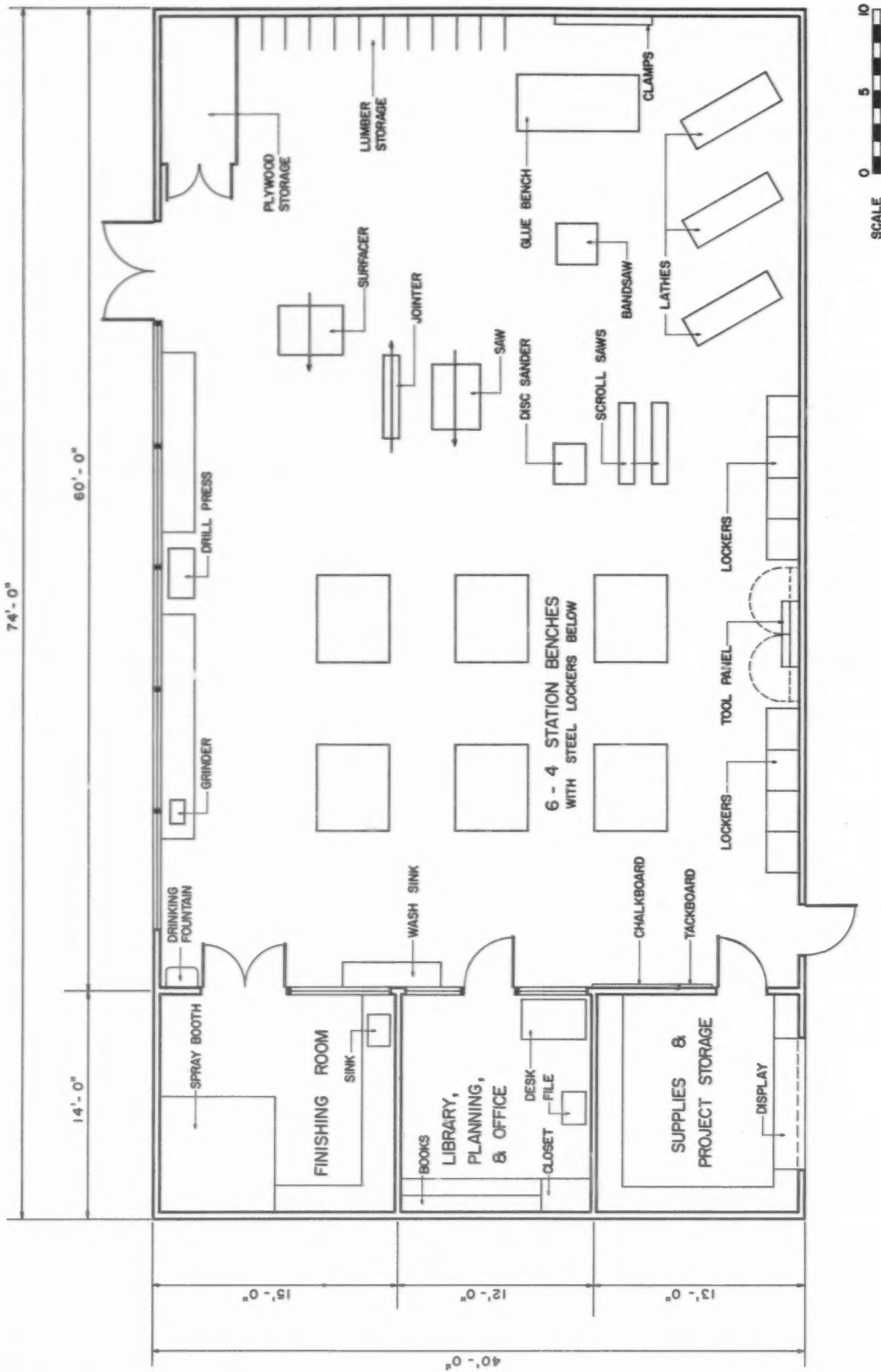


Figure 14. Industrial Arts Woods Facility
Designed for Woods Courses for Grades Seven and Eight or Seven Through Nine

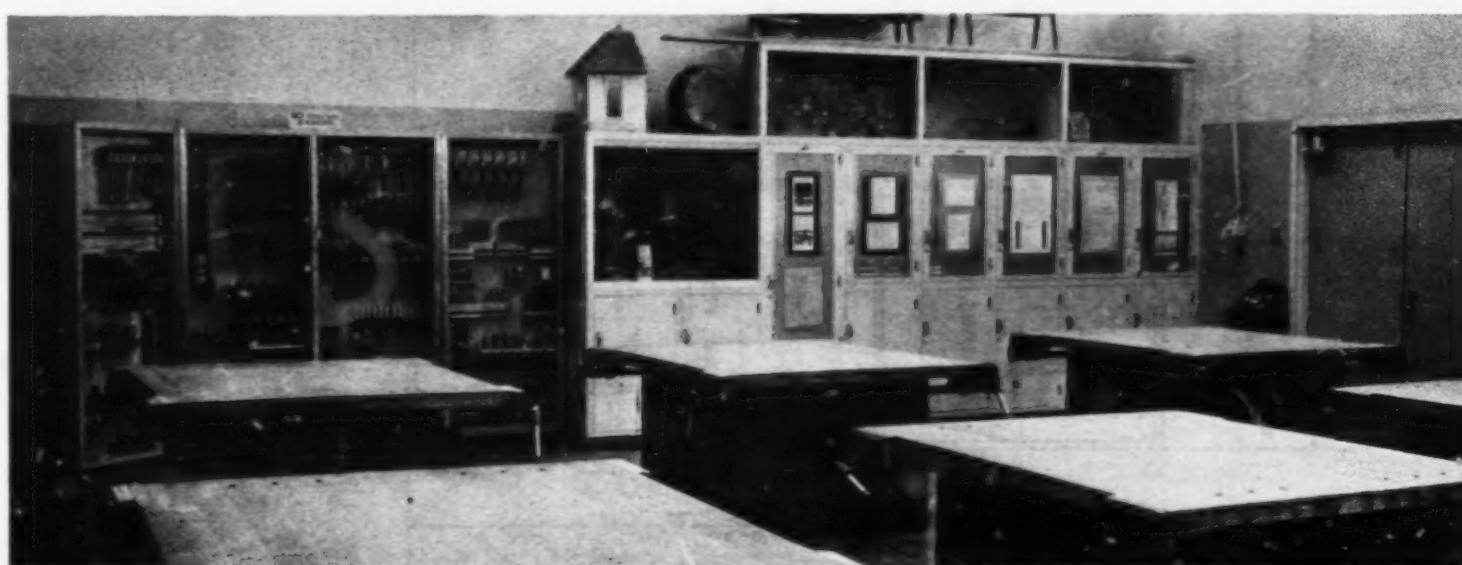
TABLE 11

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts Woods Facilities
for Grades Seven and Eight or Seven Through Nine of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Compressor, air	1	1	-	-	1	1	1	-	1	1
Drill, electric, portable	1	2	1	1	1	1	1	1	1	1
Drill press	1	1	2	1	1	1	1	1	2	1
Grinder	1	1	1	1	2	2	1	-	1	1
Gun, spray	1	1	1	-	1	1	1	1	-	1
Jointer	1	1	1	1	1	-	1	1	1	1
Lathe, woodworking	2	1	3	2	3	4	2	2	2	3
Miter box	1	1	1	1	1	1	1	1	2	1
Mortising attachment for drill press	1	1	1	1	1	1	1	-	1	1
Planer (surfacers)	1	1	1	1	1	1	1	-	-	1
Regulator, air	1	1	2	-	1	1	1	-	-	1
Router	1	1	1	1	1	1	1	-	1	1
Sander, disc	1	1	1	1	1	1	1	1	1	1
Sander, portable, belt	1	1	1	1	1	1	1	1	1	1
Sander, portable, orbital type	1	1	1	1	1	1	1	1	2	1
Saw, band	1	1	1	1	1	1	1	1	1	1
Saw, circular	1	1	1	1	1	1	1	1	1	1
Saw, scroll	1	1	2	1	2	1	1	1	3	2
Spray booth	1	1	1	-	1	1	1	-	-	1

Bench (4-station) – Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, glue and clamp; bench, planning; bench, teacher's demonstration; collector (system), dust; machine, mortiser/boring; saw, radial arm; and saw, sabre.



An open tool panel and four-station workbenches with steel lockers underneath are featured in modern woods facilities for grades seven and eight or seven through nine.

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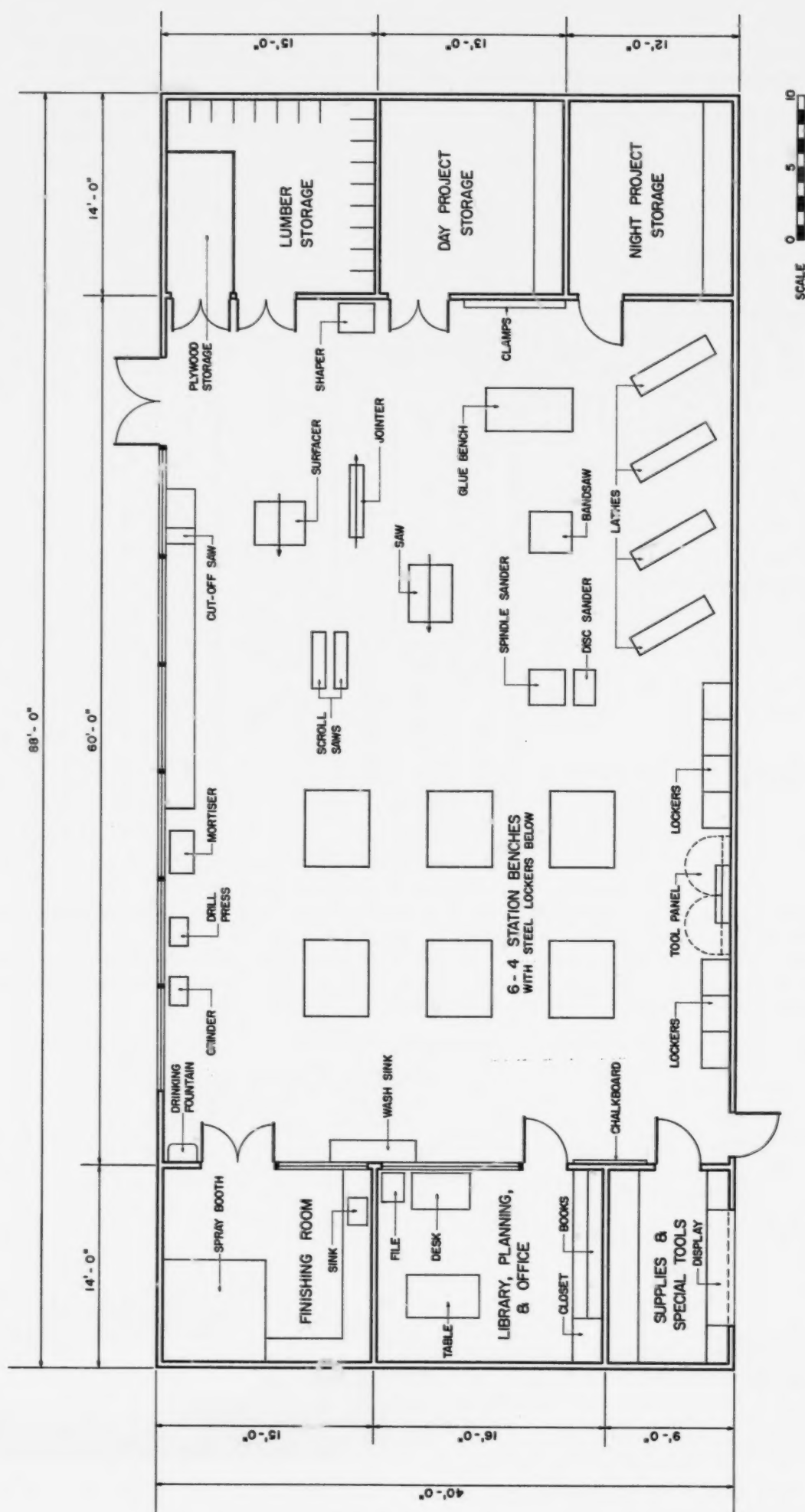


Figure 15. Industrial Arts Woods Facility
Designed for Woods Courses for Grades Nine Through Twelve or Ten Through Twelve

TABLE 12

**Major Kinds and Quantities of Equipment Provided in the Industrial Arts Woods
Facilities for Grades Nine Through Twelve or Ten Through Twelve
of Selected School Districts***

Kind of equipment	Quantity supplied by district per facility									
	Los Angeles	San Diego	San Francisco	Long Beach	Oakland	Fresno	Sacramento	San Juan	Mt. Diablo	Richmond
Bench, glue and clamp	1	1	1	1	1	1	-	1	-	1
Compressor, air	-	1	-	1	1	1	1	1	1	1
Drill, electric, portable	1	2	1	1	1	2	1	2	1	2
Drill press	1	2	2	1	2	1	1	1	2	1
Grinder, bench	-	1	1	-	1	1	-	1	-	1
Grinder, pedestal	1	1	-	1	1	1	1	1	1	1
Gun, spray	1	1	1	1	1	1	1	1	1	1
Jointer	1	1	1	1	1	1	2	1	1	1
Lathe, woodworking	4	3	4	3	4	4	2	3	3	3
Machine, mortiser/boring	1	1	1	1	1	1	-	-	-	1
Miter box	1	1	1	1	1	1	1	1	-	1
Planer (surfacer)	1	1	1	1	1	1	1	1	1	1
Regulator, air	1	1	2	1	1	1	1	1	1	1
Router	1	1	1	1	1	1	-	1	1	1
Sander, disc	1	1	1	1	1	1	1	1	1	1
Sander, portable, belt	1	2	1	2	1	1	1	1	2	1
Sander, portable, orbital type	1	1	1	1	1	1	1	1	3	1
Sander, spindle	-	-	1	-	1	-	-	-	1	1
Saw, band	1	1	1	1	1	1	1	1	1	1
Saw, circular	2	2	1	1	1	1	2	1	2	2
Saw, radial arm	1	1	1	1	-	1	1	1	1	1
Saw, scroll	-	1	2	1	1	1	1	2	1	1
Shaper, woodworking	1	1	1	1	1	1	1	1	-	1
Spray booth	1	1	1	1	1	1	1	1	1	1

Bench (4-station) – Generally 24 student stations per facility

*Certain of the districts also provide the following equipment: bench, planning; bench, teacher's demonstration; collector (system), dust; miter cutter; sander, drum; saw, power, portable; saw, sabre; and vise, patternmaker's.

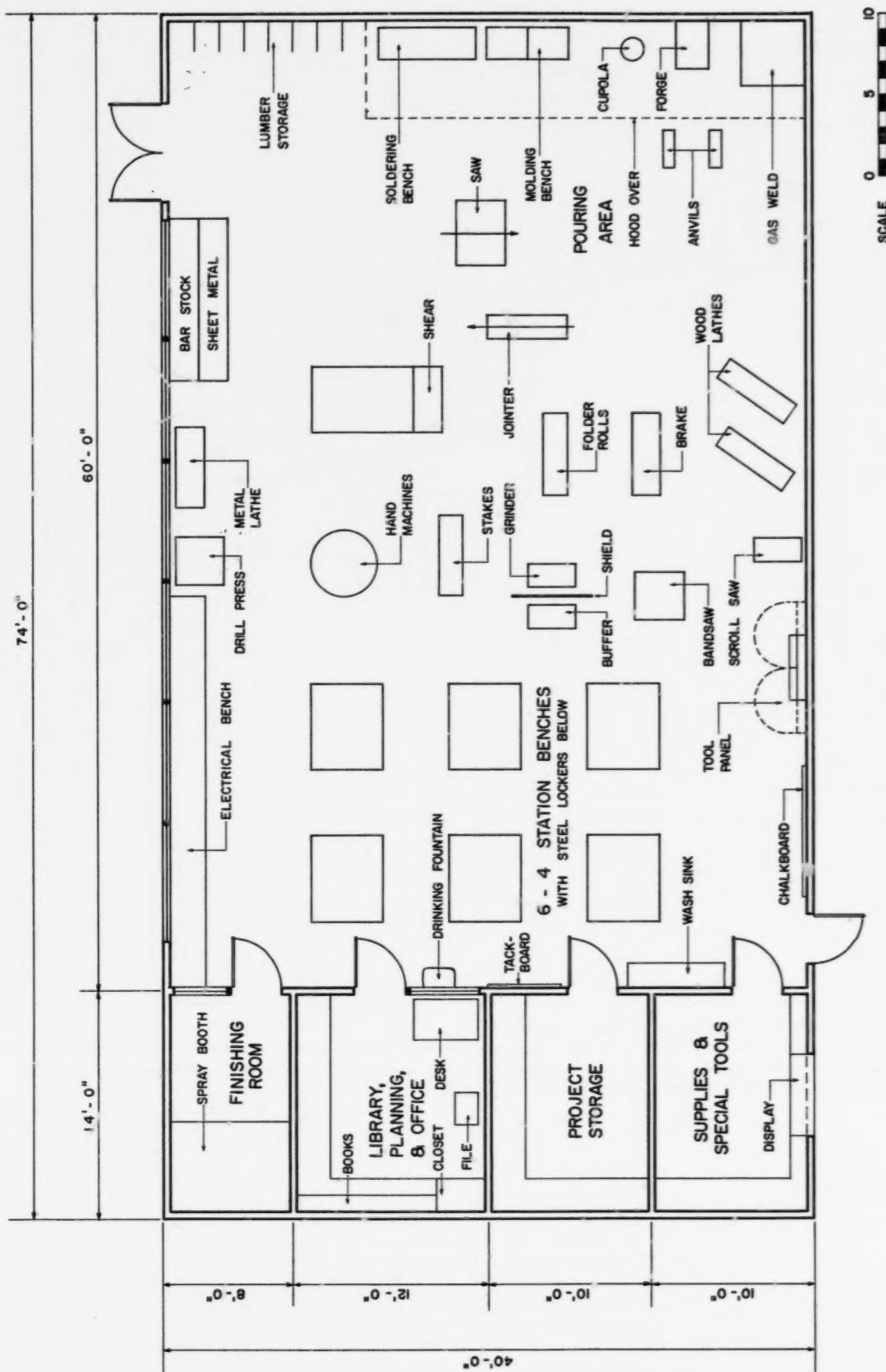


Figure 16. General Industrial Arts Facility (Comprehensive General Shop/Laboratory)
 Designed for General Industrial Arts Courses for Grades Seven and Eight or Seven Through Nine

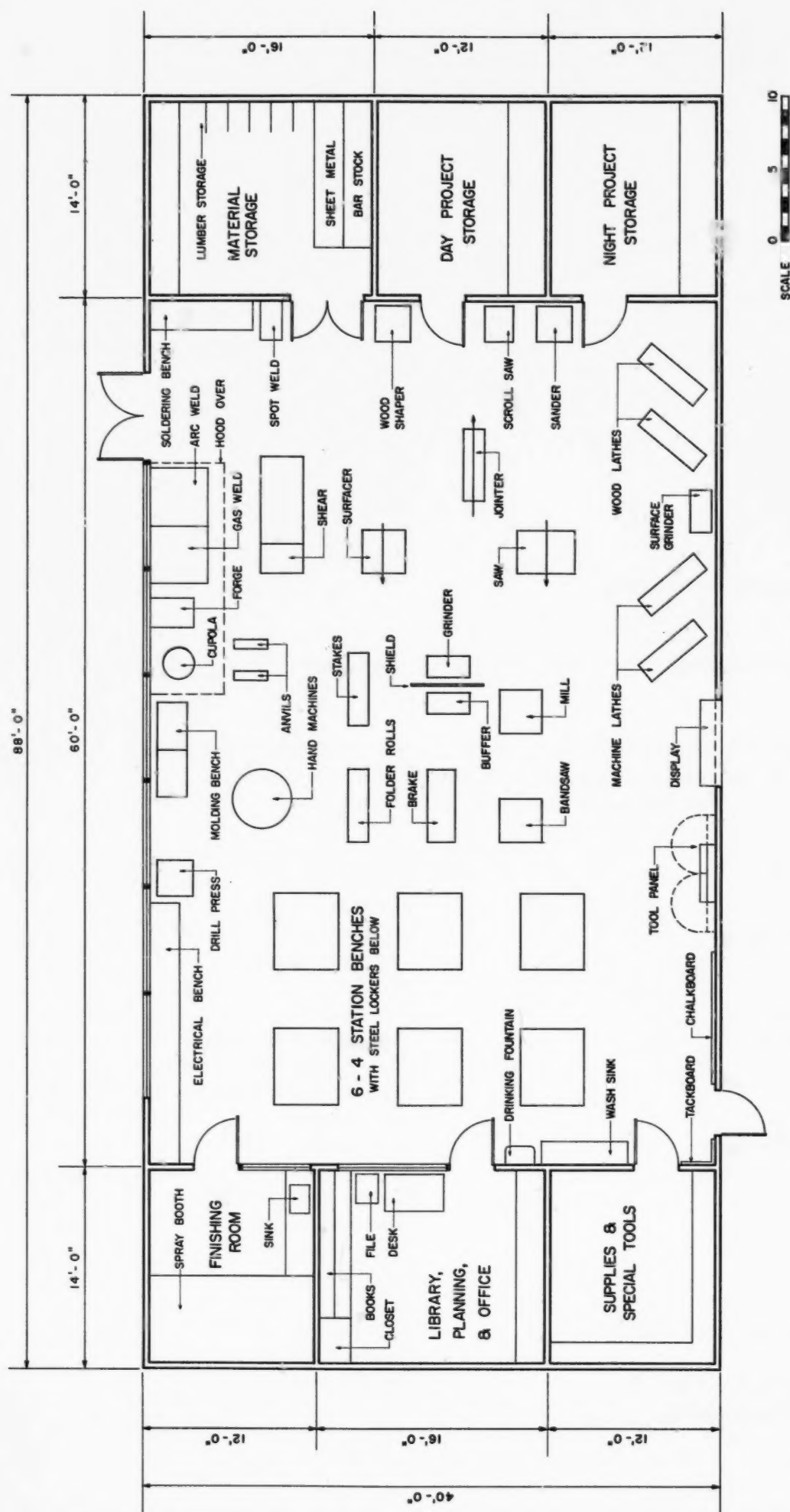


Figure 17. General Industrial Arts Facility (Comprehensive General Shop/Laboratory)
Designed for General Industrial Arts Courses for Grades Nine Through Twelve or Ten Through Twelve

**Major Kinds of Equipment Recommended for General Industrial Arts Facilities
(Comprehensive General Shops/Laboratories) for Grades
Seven and Eight or Seven Through Nine**

Anvil	Machines, hand (turning, burring, elbow edging, wiring, crimping, and beading)
Bench, electrical	Miter box
Bench, molding	Regulator, air
Brake, box and pan	Rolls, slip forming
Buffer, bench or pedestal	Router
Compressor, air	Sander, portable, belt
Cupola/furnace with crucible	Saw, band (combination metal-wood)
Drill, electric, portable	Saw, circular
Drill press, bench or floor	Saw, scroll
Folder, bar	Shear, squaring
Forge, gas fired	Spray booth
Furnace, soldering	Stake plate, mounted
Grinder, bench or pedestal, or grinder-buffer combination	Stakes, set
Gun, spray	Welding unit, gas
Jointer	Welding unit, spot
Kiln, enameling	
Lathes, metalworking and woodworking	

Benches (4-station with machinist's and woodworking vises) — generally 24 student stations per facility

**Major Kinds of Equipment Recommended for General Industrial Arts Facilities
(Comprehensive General Shops/Laboratories) for Grades
Nine Through Twelve or Ten Through Twelve**

Anvil	Milling machine
Bench, electrical	Miter box
Brake, box and pan	Planer (surfacers)
Buffer, bench or pedestal	Regulator, air
Compressor, air	Rolls, slip forming
Cupola/furnace with crucible	Router
Drill, electric, portable	Sander, disc
Drill press, bench or floor	Sander, portable, belt
Folder, bar	Sander, portable, orbital type
Forge, gas fired	Saw, band (combination metal-wood)
Furnace, soldering	Saw, circular
Grinder, bench or pedestal, or grinder-buffer combination	Saw, scroll
Grinder, surface	Shapers, metalworking and woodworking
Gun, spray	Shear, ring and circle
Hack saw, power	Shear, squaring
Jointer	Spray booth
Kiln, enameling	Stake plate, mounted
Lathes, metalworking and woodworking	Stakes
Machine, boring	Welding unit, arc
Machines, hand (turning, burring, elbow edging, wiring, crimping, and beading)	Welding unit, gas
	Welding unit, spot

Benches (4-station with machinist's and woodworking vises) — generally 24 student stations per facility

Industrial Arts for Kindergarten and Grades One Through Six

Industrial arts is an integral phase of the total program of education offered by elementary schools, for it is designed to further all the programs' objectives and to enrich the experiences pupils have in attaining the objectives. Well-planned industrial arts activities in the elementary schools, kindergarten and grades one through six, provide rich opportunities for pupils (1) to acquire knowledge of materials and of industrial processes; (2) to learn how to project their ideas through plans and how to use plans in completing projects; (3) to develop habits of using tools correctly and safely; (4) to become increasingly proficient workers as individuals and as members of their groups; and (5) to develop wholesome attitudes.

Industrial arts activities in the elementary schools place emphasis upon the planning and construction that is required in meeting needs that arise as pupils participate in science and social sciences. Instruction is carried forward so as to strengthen pupils' interest in attaining their objectives. This is, in part, accomplished by making it possible for pupils to enjoy the satisfaction of actually producing certain of the objects which they have previously only been able to visualize. In doing the required work, the pupils make practical use of certain skills they have acquired in other phases of the instructional program, acquire new skills, sharpen their ability to visualize, and in many other ways become increasingly proficient as individuals and as members of the groups to which they belong.



Elementary school industrial arts activities are conducted in a classroom by a regular classroom teacher in the Los Angeles Unified School District.

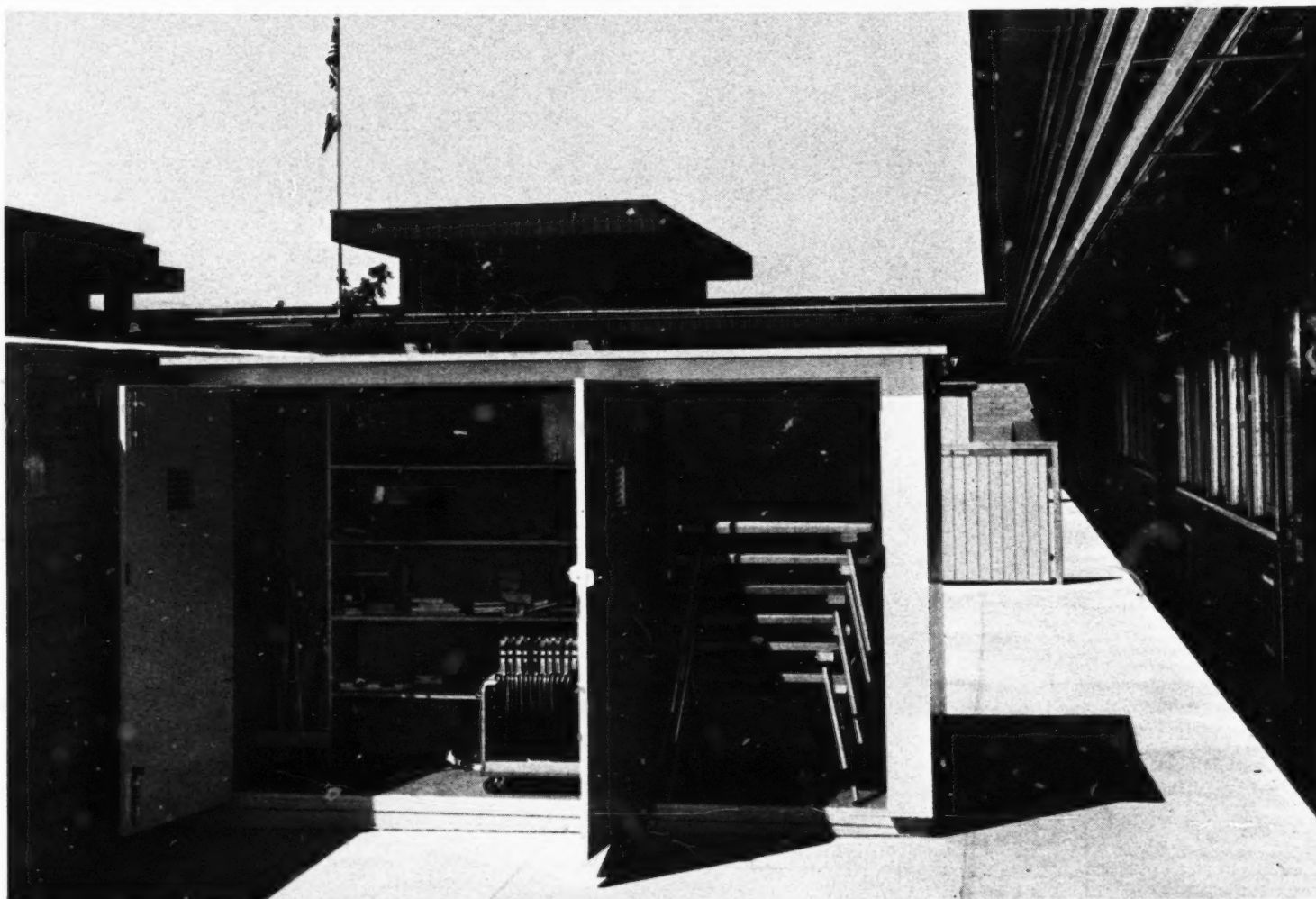
The regular classroom teacher has responsibility for conducting the elementary school industrial arts program. In assuming this responsibility, the teacher must always take pupils' interests, needs, and abilities into consideration. The teacher must then make such provisions in the program as are required by the differences that exist. These provisions will be designed to meet both individual and group requirements.

Industrial arts activities will (1) strengthen pupils' understanding of science and social sciences; (2) enrich pupils' experiences; (3) encourage further study and new interests; (4) create opportunity for functional use of language and arithmetic skills; (5) provide opportunities for pupils to develop physical coordination and wholesome emotional and social growth; (6) promote the safe use of tools and develop a desirable attitude toward safety in the school and home; (7) offer wholesome outlets for creating and making objects; (8) bring about an appreciation of the dignity of labor and the skill involved in craftsmanship; and (9) provide opportunities to work cooperatively.

The ability to use materials well, to create with his hands, and to achieve success gives to the child a feeling of satisfaction that he may never experience in other phases of the instructional program. The personal satisfaction of work done to the best of his ability and evaluated carefully often leads to the improvement of the general work habits and standards of the individual.

Basic Hand Tools Recommended for Industrial Arts Activities for Kindergarten and Grades One Through Six

Auger bits, set	Plane, block
Brace	Pliers, combination
Brushes	Pliers, side-cutting
Clamp, "C"	Rule
Coping saw blades	Safety block
Countersink	Saw, back
Divider	Saw, coping
Drills, twist, assorted	Saw, cross-cut
Expansion bit	Saw, keyhole (compass)
File, half-round (cabinet)	Saw, rip
File, handles	Sawhorse
File, mill	Scratch awl
File, round	Screwdriver
File, slim-taper	Scissors
File card	Square, combination
Hammer, claw	Square, try
Hand drill	Tin snips
Miter box	Tool cart
Nail set	Vise, portable



These photographs show an outdoor activity area and tool-material storage unit provided by the Los Angeles Unified School District for elementary school industrial arts.